INDUSTRIAL REFRIGERATION

BUYER'S DIRECTORY ISSUE

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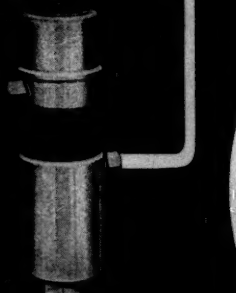
FOR REMOTE CONTROL
OF LIQUID LEVEL AND
DIFFERENTIAL-USE

ALCO 908 electronic LECTRO-LEVEL

LEVEL ALCO

on flooded evaporators,
shell and tube coolers,
and large receivers

operate sump pumps,
alarm bells, and other
electrical devices



FOR FIXED LEVEL
CONTROL USE

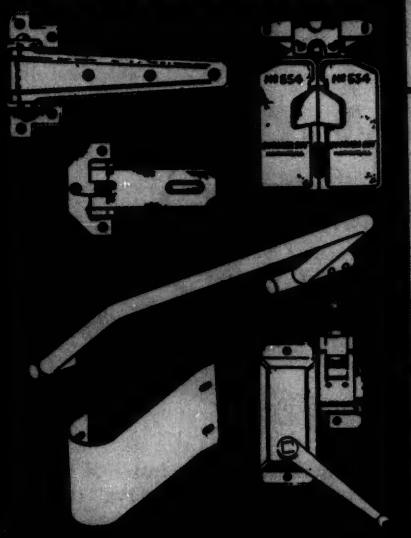
ALCO J-5 FLOAT SWITCH

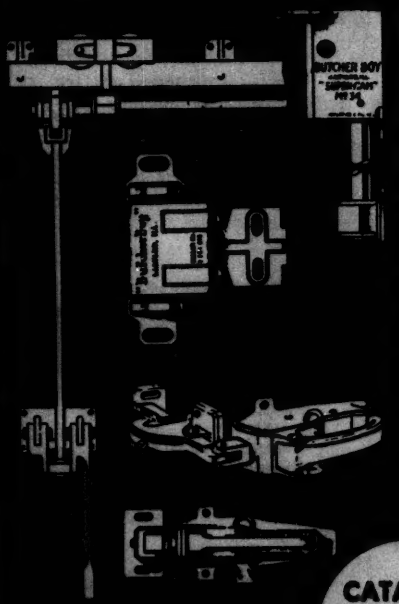
FOR SERVICE FOR LIFE

ALCO VALVE CO.

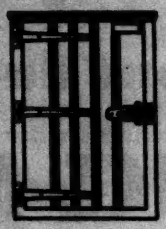
"Butcher Boy"
Since 1898

REFRIGERATOR DOOR
HARDWARE



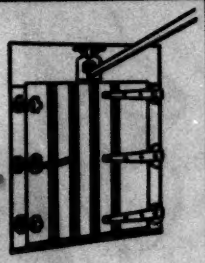


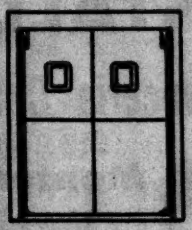
SAFETY RELEASE FASTENERS



STANDARD
COOLER-FREEZER DOORS

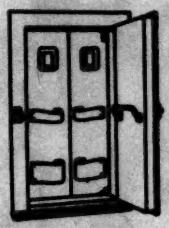
- Modern Streamlined Appearance
- 100% Douglas Fir Construction
- Massive and Durable Hardware





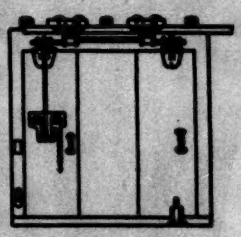
STANDARD VESTIBULE
AND AUTO CLOSE DOORS

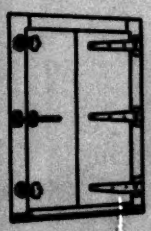
- Double Acting Doors for Loading Docks
- For Heavy Trucking Openings
- Save Refrigeration Losses



HORIZONTAL SLIDING DOORS

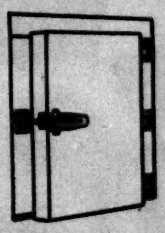
- Ideal where space factor is limited
- Recommended for Freezer Areas
- Available for manual, air, or electric operation
- Mechanically operated doors open and close in less than 4 seconds





LOW TEMPERATURE
INFITTING AND SUPER
FREEZER OVERLAP DOORS

- Low Temperature Doors for +10 to —20° F
- Super Freezer Doors for —0 to —100° F
- Both types available with No. 51 electric defrosters
- Extra heavy duty hardware applications



New!

FULLY AUTOMATIC
ELECTRIC DEFROSTERS

- Underwriter's Approved—An exclusive First with Butcher Boy
- Flexible "silicon" covered (not lead covered) heater cables
- Furnished with calibrated "thermostat"—economical heat control

CATALOGS
AVAILABLE
UPON
REQUEST

South of the Border

200 tons daily capacity

TUBE-ICE MACHINES

INSTALLATION

for **Cerveceria Cuauhtemoc, S. A.**

Monterrey, Mexico

This leading Mexican brewery installed two Vogt Tube-Ice Machines to serve their Monterrey plant several years ago, and two additional units were recently placed in operation to meet increased plant production.

Mounted on top of the ice storage building, a total of 200 tons of crushed Tube-Ice is discharged daily from the battery of ice machines to the storage room beneath. The ice is used for keeping beer cool during delivery by trucks and is supplied free of cost to refreshment stands and beer gardens where the product of Cerveceria Cuauhtemoc is sold.

In addition to making ice, distinctly versatile Tube-Ice units can be easily adapted to the production of cold water for wort cooling in any brewery. Write for Bulletin TI-3. Dept. 24A-RIIR.

HENRY VOGT MACHINE CO., Louisville, Ky.
BRANCH OFFICES:
New York • Philadelphia • Chicago • Cleveland
St. Louis • Cincinnati • Dallas • Charleston, W. Va.
San Francisco

Vogt *Automatic* TUBE-ICE MACHINES

Industrial Refrigeration

October, 1957

Now in its 66th Year of Publication

Number 4

Vol. 133

J. F. NICKERSON, Founder

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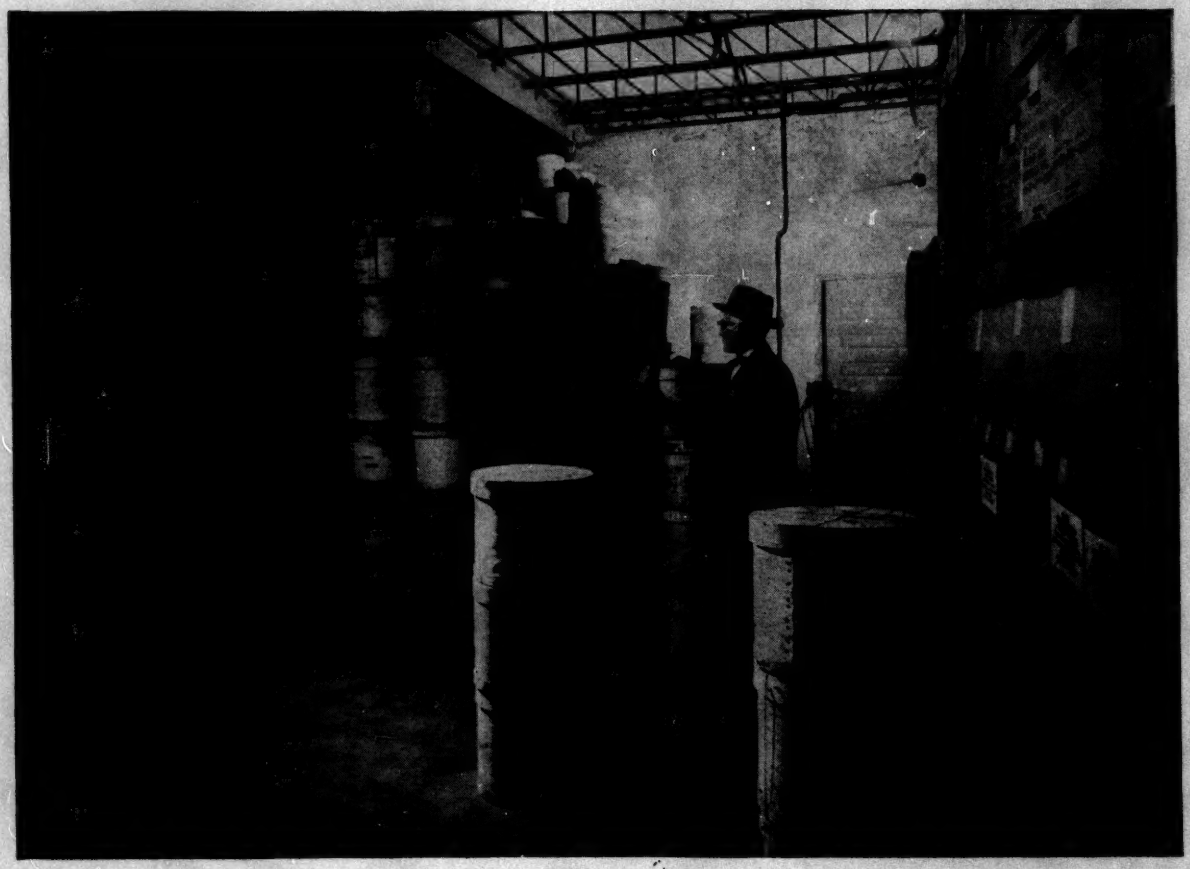


For insulation: Styrofoam brings best combination of properties

COMPARE STYROFOAM*	INSULATIONS			
	STYROFOAM	A	B	C
Low "K" factor	X		X	X
Superior Water Resistance	X	X		
High Compressive Strength	X	X		X
Light Weight	X		X	
Superior Resistance to rot and vermin	X	X		
Easy handling and fabrication	X			
Low-cost installation	X		X	
Lowest cost per year	X			

Permanent "K" factor average, 0.25. Avg. density, 1.8 lbs. per cu. ft. No odor. No food value. Pleasant to work with. Fabricates with common tools. Does not crumble or settle.

Cold storage plant's experience proves it!

Eleven years ago, Flint Cold Storage Co., a large Flint, Michigan, firm, used Styrofoam (a Dow plastic foam) to assure superior insulation in its original plant. Many additions have been made since then—including a very low temperature fruit freezing plant. And Styrofoam has been used in every case (see photo) for both equipment and building insulation.

Flint's Russell Soule writes, "We are heartily endorsing it to everyone for its low cost, high insulation efficiency, as well as its ease of installation." For complete information write THE DOW CHEMICAL COMPANY, Midland, Michigan—Plastics Sales Department 1700C-2.

*Styrofoam is a registered trademark of The Dow Chemical Company

YOU CAN DEFEND ON DOW

What's New

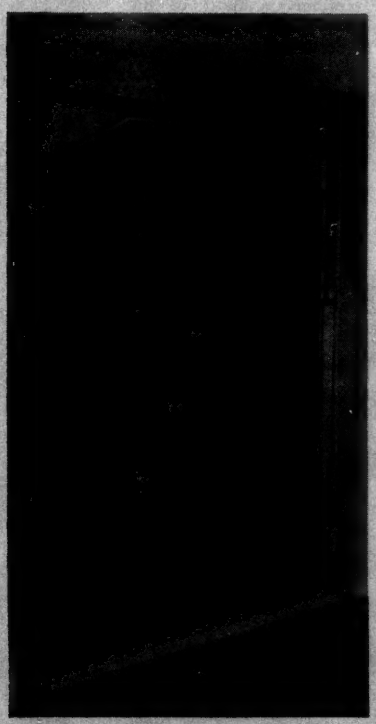
MACHINERY
APPLIANCES • PROCESSES

New Rubber Batten Doors Take Wider Pallet Loads

A NEW line of all rubber, tear-resistant batten doors has been developed by Jamison Cold Storage Door Co., Hagerstown, Md., that allows safe passage of mobile handling equipment with wider pallet loads than ever before possible. The new doors, known as Flexidor, are built to withstand the constant battering of trucks and pallets moving at high speed in and out of refrigerated storage areas. They have been especially designed to permit use of wide pallets in smaller doorways, and to take repeated abuse from off-center impact and corner cutting of power operated equipment.

General construction is such that the doors can substantially minimize the cost of maintenance and damage caused by the normal pounding of power fork lift trucks. Flexidors are especially useful where the width of the doorway is limited. A rigid batten door, for example, would require an 8 ft. opening for a 4 ft. pallet. The new rubber door needs only a 6 ft. 6 in. opening for the same size pallet. The door is made of 1/4 inch thick neoprene that has no grain. It will not tear under the most severe conditions of use. The material throughout is impervious to grease and oils, leaves no mark on carcasses of meat or packages, and stays flexible at temperatures as low as minus 40F.

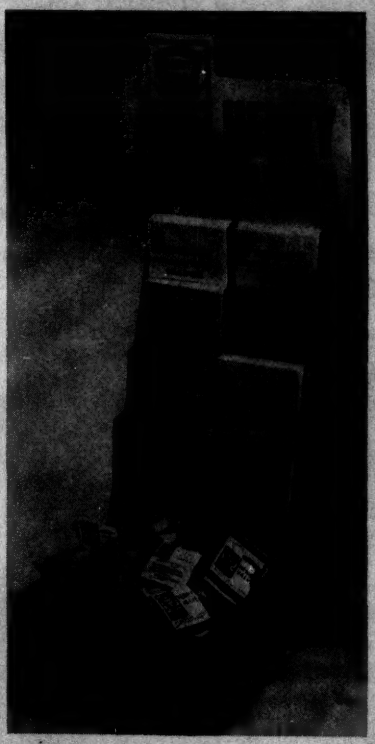
Each pair of rubber batten doors hangs freely from Jamison two-way gravity cam hinges. They are mounted so that the lower half of the doors is free-swinging and capable of absorbing the impact and shock of low loads. When pallet loads hit either door, the bottom simply flaps out, allowing the bulk to pass through without damaging the door. Reinforced, molded door noses add strength and rigidity, and eliminate curling. The noses also assure good closure and fast opening immediately on impact.



New all-rubber batten door made by Jamison Cold Storage Door Company.

Henry Counter Display

WHOLESALERS of Henry Valve Company have received a most unusual type of counter display entitled "Henry Information Center." It is made of steel and requires only a minimum of jobber's counter space.

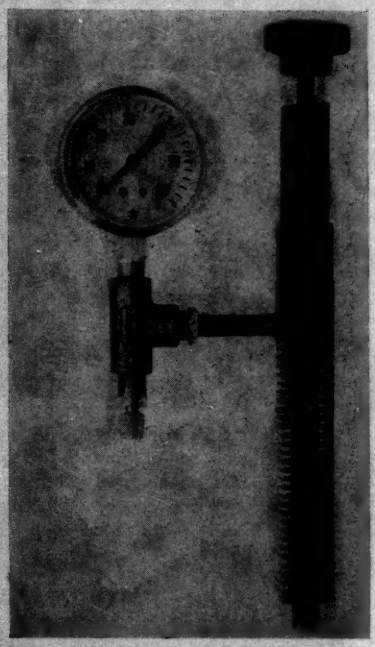


The new Henry Valve Counter display

Terraced compartments hold small descriptive pamphlets of various Henry products. The base of the display is formed to hold packets of matches. Initial folders furnished with the display describe Henry packless valves, wing cap valves, pressure relief valves, strainers and filters, and Abso-Dry pressure sealed driers.

New Vaporizing Valve

A NEW Model I Vaporizing Valve, for use in controlling expansion of vapors such as those used in refrigeration systems, petroleum refineries, and chemical plants, is announced by Manufacturers Engineering & Equipment Corp., Hatboro, Pa.



Vaporizing Valve by Manufacturers Engineering & Equipment Corp., Hatboro, Pa.

The new Vaporizing Valve permits controlled expansion of condensable vapors with volume expansions up to several thousand to one, while maintaining intimate thermal contact with room ambient. Condensation is minimized or prevented entirely. The radial input aperature is controllable in microniches.

Units with electric heaters and for automatic control are also available. Input pressures in all of the units can be up to several hundred lbs. per square inch. Standard materials of construction are brass or type 316 stainless steel, unless specified otherwise.

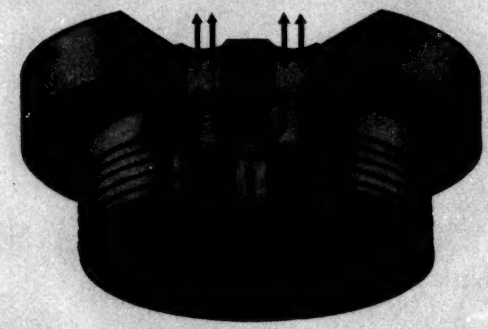
Bulletins on Single-Stage Turbo Compressor

BROCHURES on single-stage Turbo Water Cooling Systems, one on 115 to 350 tons capacity and one on 350 to 600 tons capacity have been issued by the York Corp. These systems, the brochures say, simple to operate, give quiet, efficient performance and require comparatively little space. They introduce the latest advancement in refrigeration engineering and are designed and constructed for efficient performance. Single-stage design permits the use of a simpler, smaller system that pays its way in space savings and reduced installation and maintenance costs according to York.

PERFORMANCE!

New BALL VALVE

INCREASES THE PERFORMANCE OF ANY COMPRESSOR—OLD OR NEW



New "BV" Ball Valve passes 26% *more gas* in actual tests conducted by a leading independent research organization. Users report amazing increases in performance when they install Ball Valves. And, not one report of failure in operation—Ball Valves are free from valve breakage!

EASY TO INSTALL

No drilling or tapping — BV is simply screwed in, then locked in place in seconds with the special locking ring.

STANDARIZED

SUCTION VALVE ASSEMBLIES FOR MOST COMPRESSORS

For:
Y-7½ x 7½

For information on improving your compressor performance, send us the name, bore, stroke and speed of your machine.

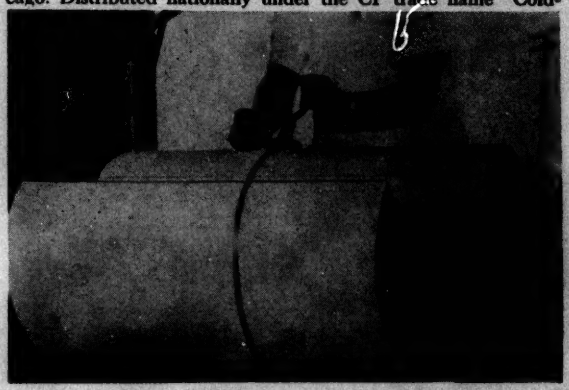
BALL VALVE CO.
P.O. Box 53 • Kansas City 41, Mo.

Some franchise territories open. Write for information.

VALVES CARRIED IN STOCK FOR LEADING HEAVY DUTY COMPRESSORS

New Lightweight Insulation for Pipes

THE addition of a new line of pipe and fitting insulation for dairies, breweries, food and chemical processing plants, is announced by The Creamery Package Mfg. Company of Chicago. Distributed nationally under the CP trade name "Cold-Pruf", the insulating material is made of Dow Chemical Company's expanded polystyrene "Styrofoam". The material is prefabricated for CP in a wide variety of thicknesses as well as many shapes for fitting covers. Installation is said to be quick and simple, with the plant using its own crew. "Styrofoam" can be cut on the job with an ordinary knife or saw, without crumbling or cracking.

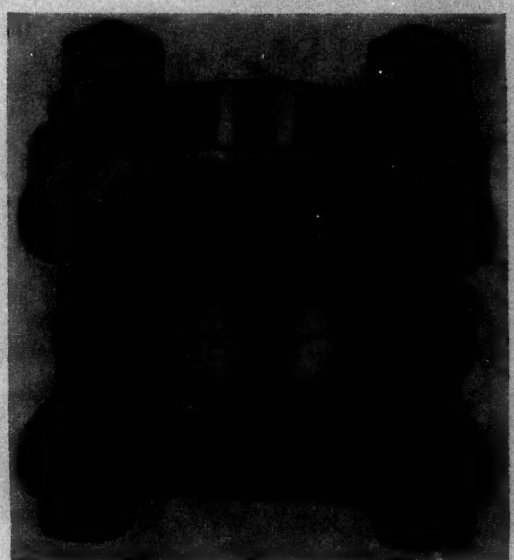


Applying new "Cold-Pruf" pipe insulation.

Pipe, vessel and fitting covers are available in standard sizes in eight thicknesses for immediate shipment. Galvanized steel, bands and ground "Styrofoam" for filling are provided. If desired, Creamery Package also provides a special coating for color coding lines in National Safety Council approved colors.

Forged Steel Welding Flanges

THE prompt availability of all sizes, plus no increase in cost are two important economy features of the Wolf-Linde Socket Type Welding Flanges, according to the manufacturer, Dersch, Gesswein, & Neuert, Inc., Chicago. The self-aligning deep socket permits quick and easy installation without costly precision cutting and beveling of pipe. Flanges are offered in sizes ¼ to 12 inches inclusive. They are compact, shock resistant and of high strength with tongue and groove construction.



The Wolf-Linde Type Welding Flange.

PRESS BRIEFS

Cyrogenic Conference On Effect of Cold on Metals

HOW metals and other materials behave at temperatures of 400 degrees below Fahrenheit and colder was discussed at the 1957 Cyrogenic Engineering Conference in the National Bureau of Standards Laboratories, Boulder, Colo., August 19-21. At least 500 people, some 100 more than last year, attended the sessions Monday, Tuesday and Wednesday. They are engineers, physicists and others from low temperature laboratories from all over the nation.

The 44 papers read at the meetings dealt with a laboratory world where temperatures tumble hundreds of degrees below the coldest ever naturally recorded on earth. Much research work in cyrogenics, the science of extreme cold generation, deals with developing instruments and materials that can stand the super-chill. One report described a synthetic glue that even at cyrogenic temperatures retains its strength of more than four tons per square inch. It is used for bonding materials together.

Ban on Ice Cubes Lifted

ICE, for a price, is once more available at Delaware liquor stores that want to handle it as a service to their customers. The Alcoholic Beverage Commission notified package store licensees that it is okay for them to sell ice cubes at "local prevailing prices."

The commission's directive did not, however lift a ban on ice give-aways which its agents started enforcing last winter. Free ice is still classed as an "inducement to sale," and prohibited by commission rules. The notice added ice cubes to a rule permitting sale of "bottled beverages recognized as mixers for use in connection with the preparation of alcoholic drinks."

The commission carefully avoided pegging specific prices for ice, which is sold in the Wilmington area for up to 50 cents for a 10-pound bag. It also made no mention of maximum or minimum amounts of ice that can be sold.

The order made no mention of the quantity that may be sold, a commission aide pointed out. "If the going price in a dealer's area is 50 cents for 25 pounds, there would be nothing to stop him from selling a five-pound bag for a dime or a one-pound bag for a couple of cents."

Conrad Hilton Announces Air Conditioning

THE Conrad Hilton Hotel, Chicago, Ill., announced the completion of its air conditioning project Tuesday, September 17, 1957. A buffet luncheon and cocktails were served following the ceremony. The refrigeration plant amounts to an aggregate 1600 tons. Two York 800 hp Refrigerant-11 centrifugals driven by synchronous motors will serve the refrigeration system. Rooms are air-cooled or heated as required in this year-round air conditioning application by York induction system consisting of 3300 units. To complete the project, the Conrad Hilton brought in additional 4500 KVA to satisfy their AC power demand. In the process the hotel completed conversion of its lighting and power changeover from DC to AC, a project of several years operation.

GENUINE OZITE®

the perfect PIPE COVERING INSULATION

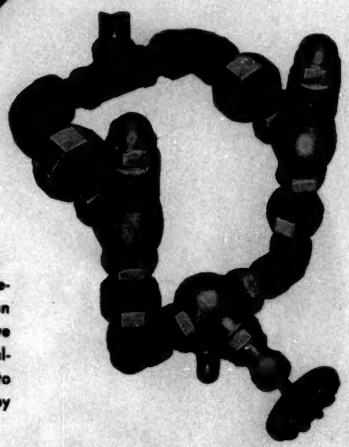
- *Maintains uniform temperature*
- *Increases refrigerating capacity of the equipment*
- *Reduces power consumption*
- *Never rots or decays*

The quickest, easiest way to stop wasteful heat absorption is to cover all pipes and ducts with OZITE Standard Hair Felt. It gives better insulation because it is made from 100% genuine cattle hair, nature's own insulation.

a product of
AMERICAN HAIR & FELT COMPANY
MERCHANDISE MART • CHICAGO 54, ILL.

SHANK
AMMONIA
VALVES

Engineered for Accuracy and Built for Dependability

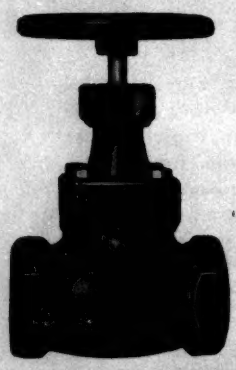


SHANK
RELIEF VALVE
ASSEMBLY

Petro Unions for ease of replacement. In the event of an emergency, the 3-way valve can be opened half way allowing both relief valves to function. ½" size certified by N.B. and A.S.M.E.

COMPARE THESE CAPACITY RATINGS

½" size Capacity Lbs. / Min. Air	Set Popping Pressure of Valve Lbs.
6.9	50
9.6	75
12.3	100
15.0	125
17.6	150
20.1	175
22.8	200
25.4	225
27.9	250
30.5	275
33.0	300



SHANK
BOLTED BONNET
SHUT-OFF VALVE

Heavy-duty construction. Made of semi-steel. Back-seating is provided for repacking while valve is under pressure. Seat is made of soft metal alloy-swivel and self-aligning. Ample ports provide full-pipe capacity. Hand wheels proportioned for easy operation.

IMMEDIATE DELIVERY ON OUR COMPLETE LINE
Send for catalog.

CYRUS SHANK COMPANY

4650 West 12th Place, Chicago 50, Illinois

Beatrice Foods Opens Greeley Plant

MEADOW GOLD products were introduced into the Greeley, Colo. area recently when Beatrice Foods Co. opened its modern dairy plant in that city. The building is 240 x 120 ft. with a 67 x 54 ft. refrigerated wing. The building is of steel frame with curtain walls of masonry and pre-cast concrete.

Approximately 280 dairy farmers produce milk for this plant, most of them within a 25 mile radius of Greeley. Production is entirely Grade A with about 6600 cows supplying the milk required. Beatrice Foods estimates that these producers will earn approximately $3,300,000 for this production effort annually.

General work in processing areas and equipment in the new plant include: general office and administration area; raw milk receiving room; raw milk storage area; processing plant; case and bottle washing room; tank and truck receiving area; cheese manufacturing room; process milk storage; pure pack filling room and, of course, an engine room. Approximately 25,000 sq. ft. is covered by the building which is located on a 3½ acre site. There are no windows in any of the processing areas. Air circulation is maintained by a ventilating system which gives a complete change of air every three minutes after thorough filtering. A detailed illustrated story of the new plant will appear in INDUSTRIAL REFRIGERATION at an early date.

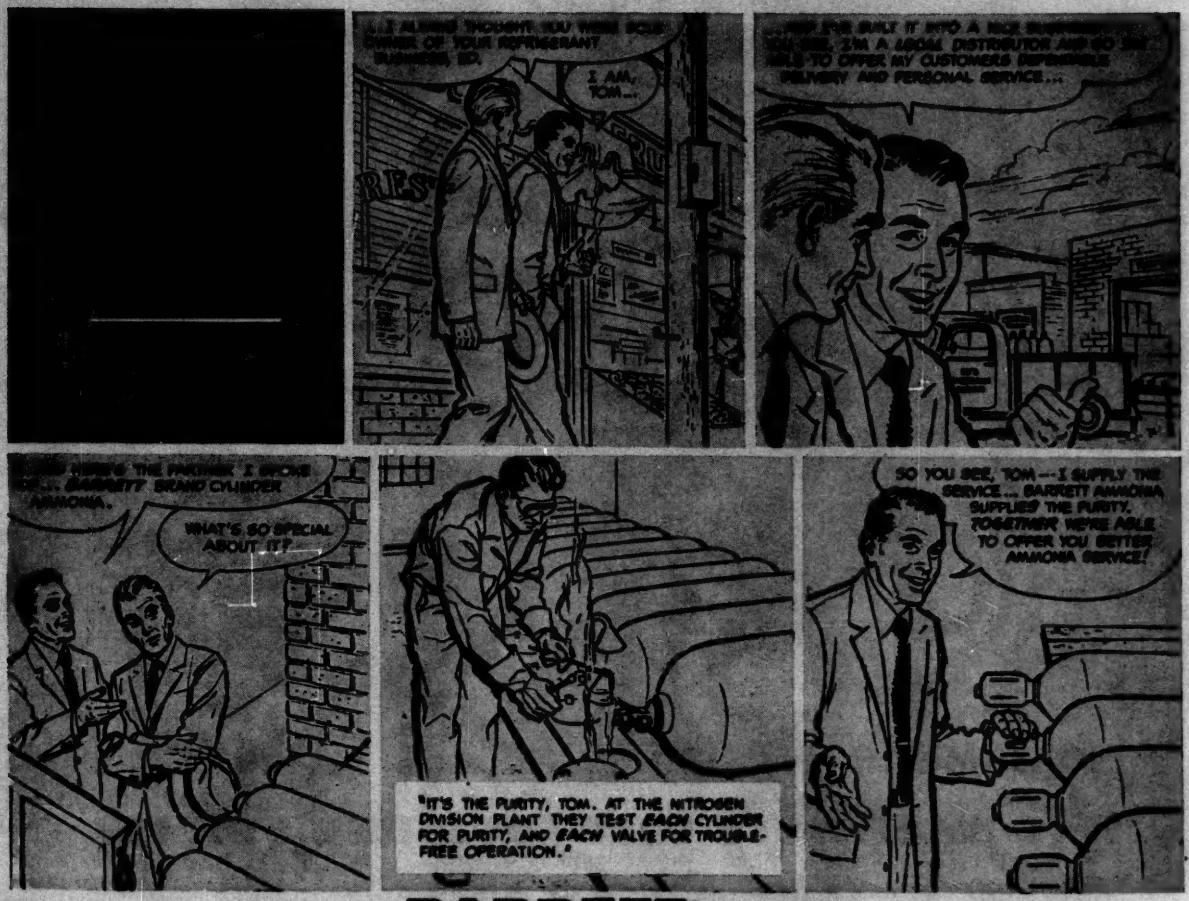
Shipping Line Claims The Coolest Head

RECENT advertising by one of the West Coast shipping firms in produce and transportation trade papers emphasized the care and consideration given to perishable products. This firm pictured a large dewey head of lettuce over which they superimposed their produce inspector with an open case of the product. Type copy in the advertisement led off with "The Coolest Head at APL". Following that statement, the firm noted that their produce inspectors check refrigerating commodities at loading time and advise shippers of any deviations from standard quality and temperature. They emphasize this extra safeguard, plus top-flight refrigeration engineering aboard ship, means fresh fruit and produce for the shipper's customer. Their claim to this exclusive service raised a question with INDUSTRIAL REFRIGERATION'S correspondent as to where the idea originated, with modern warehousing practices here in the United States, with government inspection practices expanded during the recent war, or actually with the steamship company. At any rate, the correspondent concluded that the idea, the advertising and the actual practice for such inspection can probably attract similar favorable reactions with the warehousing industry, if publicized.

Dry Ice Plant Sold by Court

A HALF-MILLION dollar dry ice industry, the dream of the Northeastern New Mexico town of Des Moines, population about 300, was sold recently to satisfy creditors. The building and equipment of Gruemmer Carbonic Indian Ltd., was sold on orders from U. S. District Court in Des Moines, Iowa. They were valued at $447,100 in October, 1955. Assets were sold piecemeal.

Not present at the sale was Bible-quoting, quick-talking Henry Gruemmer, 42, who built a half million dollar empire around holes in the ground. It collapsed when he was found guilty and sentenced to five years in federal prison last February on fraud charges.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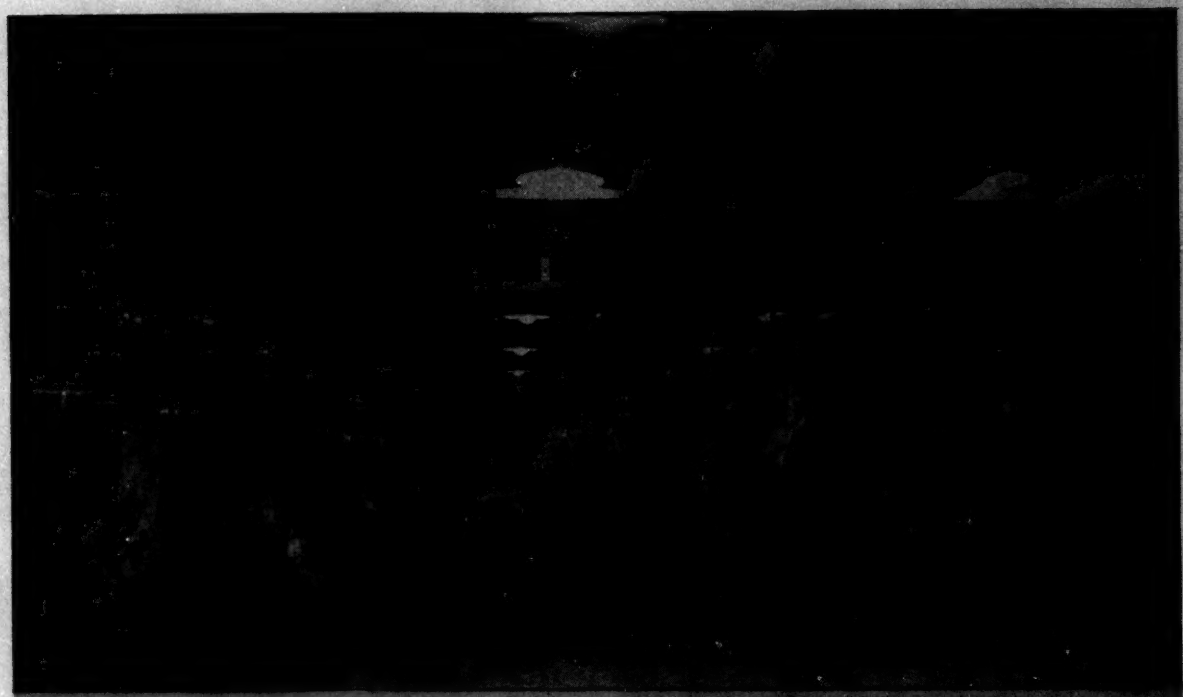

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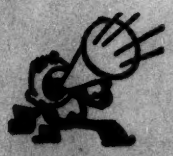

In the Spotlight

WRITING for NAPRE's Educational Committee, Director M. E. Bell pointed out last month in "Reduce Power, Fuel and Water Costs" that turbine drives, often overlooked, can be utilized for stretching a fuel dollar. Another brewery engineer confirms that well-made point in an account this month on added refrigerating capacity. "Steam-powered Centrifugal For Economical Heat Balance", by Donald W. Poulton, points up additional economic advantages of NH_3 centrifugal boosters for space saving, minimum maintenance, and seasonal flexibility at Schmidt's, Philadelphia. See Page 13.

BOILERS WILL give way to boosters for heating applications! In Air Conditioning with the Air Source Compound Heat Pump, page 20, Sydney M. Miner, the author, not only presents a convincing case for the two-stage atmospheric sink heat pump application—he suggests that booster compressors will replace the low pressure steam or hot water heating boiler, in more northerly industrial and commercial installations! Plants of this nature are installed and operating. Performance data backs up the author's contentions.

Further, Miner implies that it is the refrigerating engineer who has contributed the most outstanding energy conservation (fossil-fuel saving) development to the heating field in recent years. The two-stage heat pump is a direct out-growth of the multi-stage refrigerating system which has proven so efficient for dairies, cold storage, food freezing, etc. His viewpoint is especially refreshing, coming at a time when many refrigerating men are inclined to consider the air cooling media as their ultimate contribution to air conditioning.

IN A RECENT plant expansion, the Falter Packing Company added 18,000 feet of additional floor space. Since part of the new addition included low temperature freezer-storage facilities, the expansion meant increasing the plant's refrigerating set-up. Falter accomplished this for less than 60 per cent of the estimated cost of additional compressors and piping for the new addition. Read how they did it on page 17.

A NEW warehouse with 20 million pounds capacity will be built by the Los Angeles Cold Storage Company, subsidiary of California Consumers Company. Refrigerated warehouse space will occupy the major portion of the building, the remainder to be used for office and dock space. For story and architectural drawings, see page 26.

THE THIRD Annual Buyer's Directory for the Industrial Refrigeration Industry is published in this issue, starting on page 29. As in previous issues it consists of a list of products used in the industry, manufacturers of these products and their branch offices and trade names of products identified with certain manufacturers. This directory furnishes an up-to-date collection of information that will be useful to readers interested in the subject throughout the year.

READERS may be amused by the opening remarks in the NAPRE lead this month. However, both management and engineers will recall times when a derangement of their prime equipment brought on a bewildered, cold-feet feeling, to themselves. The Association's Educational Committee is showing some sound leadership in presenting articles of trouble shooting nature such as starts on page 50.

UNUSUAL feature of the 48th Annual Meeting, NAPRE, will be the dual educational presentation. Air conditioning and industrial refrigeration topics will be presented simultaneously. This arrangement will provide attendants an opportunity to more effectively use their time, as sessions will be held mornings only. Afternoons will be free for Show visits. Review of program starts on page 60.

ROCKY Mountain state populations have increased their appetites for milk products along with their per capita growth, just like the Pacific Northwest. Industrial Refrigeration no sooner reported on the new Carnation, Seattle, plant when news reached the Editor's desk of Meadow Gold's Greeley, Colo., building. An illustrated story on this new plant will appear in an early issue.

BAKERS are investigating freezing as a production weapon to combat the sharp peaks and valleys in the scheduling of labor for bakery products, it has been revealed by Thomas E. Derby, American Viscose Corp., Film Division Philadelphia, Pa.

Freezer Burn Smoke?

THE STORY is told of a poultry dealer, who may have been facing a declining market, alleged that a cold storage operator had not protected his frozen poultry adequately and it had suffered "freezer burn". The warehouseman went to his customer with some samples to get more facts because the poultry seemed generally to be in good condition.

After the customary fencing conversation, the warehouseman came to the point and the customer, at great length, insisted that the poultry had freezer burn. In fact, he said that his foreman, Hymie, was a specialist in freezer burn and called him to look at the poultry.

"Hymie," the customer said, "didn't you say this poultry has freezer burn?" Hymie, with a lot of bustle and fuss and the manner of a professional, looked at the poultry, smelled it ostentatiously and said: "Sure, it's got freezer burn, I can smell the smoke." —TRRF Bulletin.

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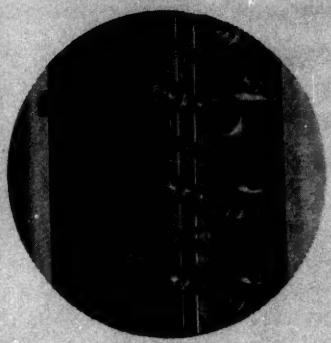

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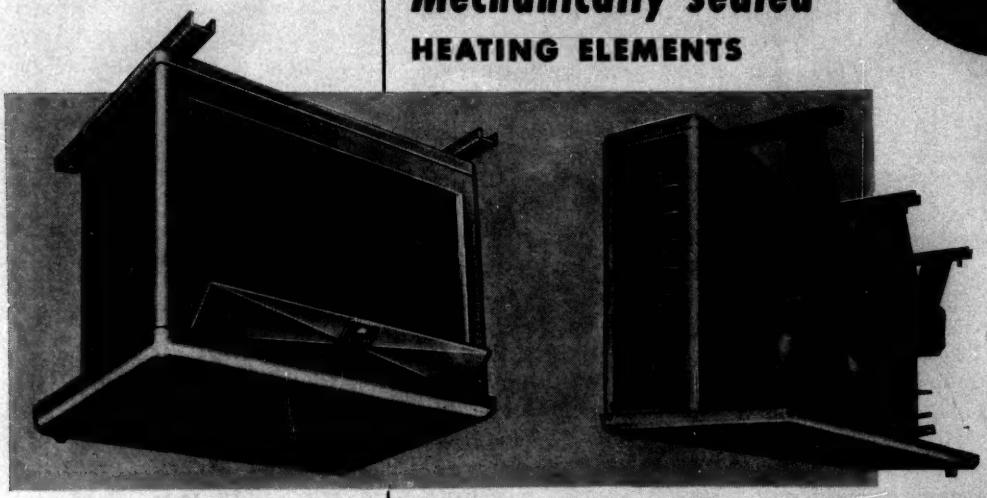

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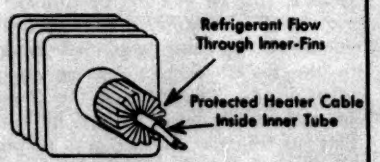

No defrost problems with these Dunham-Bush low temperature units! *Mechanically sealed* heating elements provide *positive* protection against entry of water into system. Defrosting is safe . . . sure . . . complete. And control kit (furnished) makes defrosting *entirely automatic.*

Inner-Fin® coil construction, exclusive with Dunham-Bush, permits units to defrost *from the inside.* Heat source for defrosting is a specially designed heater cable contained within the inner tube. Greater surface area which Inner-Fin construction provides assures rapid distribution of heat, quicker defrosting and minimum room temperature rise.

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AIR CONDITIONING, REFRIGERATION, HEATING PRODUCTS AND ACCESSORIES

Requiring More Refrigeration Capacity Philadelphia Brewery Turns To

Steam Powered Centrifugals For Economical Heat Balance

DONALD W. POULTON
Chief Engineer, C. Schmidt & Sons, Inc.
Philadelphia, Pa.

End view, Tandem Centrifugal Boosters with Turbine Drive.

BOOSTING refrigeration capacity while achieving optimum economical heat balance is one problem with which successful breweries, dairies, food process plants and meat packers must inevitably contend. One solution to such refrigeration "growing pains" is pointed up at the Philadelphia plant of C. Schmidt & Sons, Inc., where two centrifugal compressors were recently installed in a booster type direct expansion ammonia system.

The most common refrigeration system in use in the brewery field today is, of course, the ammonia direct expansion system with reciprocating compressors. But in the larger breweries—those requiring over 1000 tons refrigeration—the explanation of this fact is largely historical. That is, reciprocating machines antedated the much more compact and powerful centrifugal compressors which are now available.[1]

Within the past few years, however, the advantages of centrifugal compressors—high capacity in limited weight and space, with extremely low rotative pulsation—have through steady design improvements become available for direct ammonia expansion systems. The development of such compressors is of special significance to the large brewery with thousands of dollars already invested in an ammonia reciprocating system; the very plant most crucially faced with the problem of increasing capacity without constantly enlarging its engine room. Furthermore, the advent of direct-compression centrifugals has resulted in substantial power savings by making heat (steam) furnish the cold.

Steam turbines are ideal drives for centrifugal refrigerant compressors because they are designed for the same high speeds and may be direct connected. With the brewery's large demand for low-pressure process steam, the steam turbine can be used as a reducing valve. Power for the centrifugal, which becomes in effect a by-product of the main steam requirements, is thus obtained at virtually no cost. In addition, the variable speed of the steam turbine-driven machine offers a wide range of stable operating points, thereby making available a single machine of variable capacity.

Two Carrier centrifugal compressors at the Philadelphia plant provide a notable example of how these machines can economically boost efficiency and flexibility of an existing ammonia refrigeration system.

Quarter Century Required Four Refrigeration Changes

Established in 1860, Schmidt's now has a brewing capacity of 1,600,000 barrels per year at its Philadelphia plant. The firm's post-prohibition growth has been marked by a steady accretion of electric motor driven reciprocating compressors—two 212-ton units in 1936, two 212-ton units in 1939, and two 290-ton units in 1947. The aim of the brewery throughout was to have sufficient refrigeration capacity to permit (or provide against the emergency of) the shut-down of one machine.

In 1955 the brewery was again faced with the need for more capacity, with an anticipated top demand of 1650 tons of refrigeration. Preliminary survey of plants in this tonnage class, revealed a trend toward centrifugal compression. With electric power demands already nudging the company's top transformer capacity, Schmidt's turned to the 165 psig boiler steam as a low-cost source of power for their additional refrigeration requirement of 330 tons capacity. The steam turbine—centrifugal compressor installation, it was also determined, would require the least amount of modification to the existing operation.

Economical Steam Power

Not only would centrifugals require less space than additional reciprocating units, but the existing power "reserve" of boiler steam could not

[1]Although centrifugal compression was first applied to the refrigeration cycle by Dr. Willis Carrier in 1922, the early compressors were designed to operate on gases with higher molecular weights than ammonia, with its low weight of only 17.

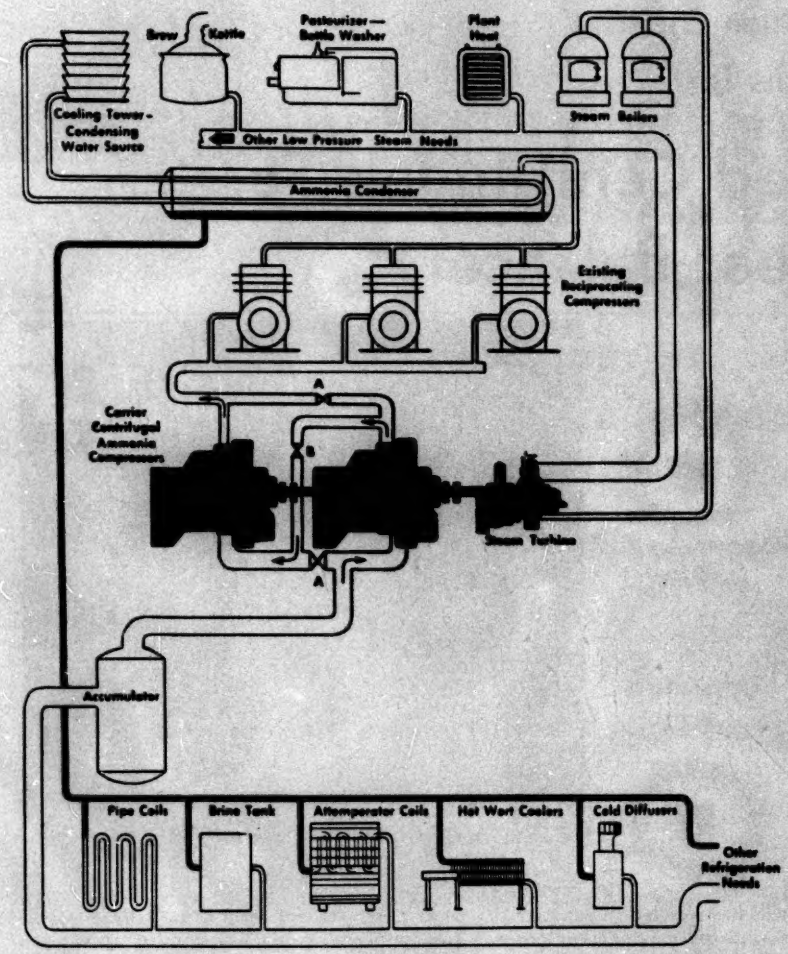


Fig. 1—Schematic diagram of Schmidt's refrigeration cycle. In summer parallel operation, valves "A" are open, valve "B" is closed. In winter series' operation (follow arrows), valves "A" are closed, valve "B" is open.

economically be used with the latter. Reciprocating compressors are impractical, of course, for steam turbine drives because of the wide difference in rpm characteristics and the consequent problem of large gear reduction. Reciprocating steam engines, integral or separate from the refrigerant compressor base, not only indicated heavy maintenance but bulk space requirements which were out of question.

Maximum 24-hour steam requirements of the brewery are 1,200,000 lbs., with 50,000 lbs. average peak per hour. Two 50,000 lb.hr. boiler units (both operate in winter, one in summer) generate steam at 165 psig. Where boiler pressure steam was formerly reduced by numerous stations throughout the plant, a Terry steam turbine which drives the centrifugals now exhausts the boiler pressure steam to the required 65 psig process pressure from a central location. A small amount of the total heat energy in the steam develops a maximum of over 500 horsepower, thus providing power for refrigeration at nominal cost. The steam piping and temperature control equipment throughout the entire plant was resized and installed where necessary, with minimum inconvenience and no major shutdown of process equipment.

Centrifugals Boost Capacity

With the steam-turbine acting as a reducing valve, two three-stage centrifugal compressors are used in a booster-type application—analagous to the super-chargers employed on internal combustion engines. Manufactured by Carrier Corporation, Syracuse, New York, the two 18-Series centrifugal compressors handle all the gas from the load, and boost the suction pressure in the suction header to the reciprocating compressors (see Fig. 1). By raising this pressure and therefore the weight flow to a reciprocating compressor, the refrigeration capacity of the reciprocating unit can be increased by a factor far greater than the small increment of additional horsepower required.

The actual operating example which follows underscores this essential feature of the direct-expansion booster system:

The 4-cylinder 14-in. x 12-in. reciprocating machines are driven by electric synchronous motors at 240 rpm. At former suction pressure of 25 psig, and a discharge pressure of 185 psig, the reciprocating unit has a capacity of 290 tons refrigeration, and brake horsepower required is 377.

If the back-pressure is increased to 60 psig (by the centrifugals), this same reciprocating compressor at 185 psig discharge pressure and 240 rpm is rated at 558 tons capacity and brake horsepower is 412—a 92 percent increase in tonnage with less than 10 percent increase in brake horsepower input!

Installed for Parallel or Series Operation

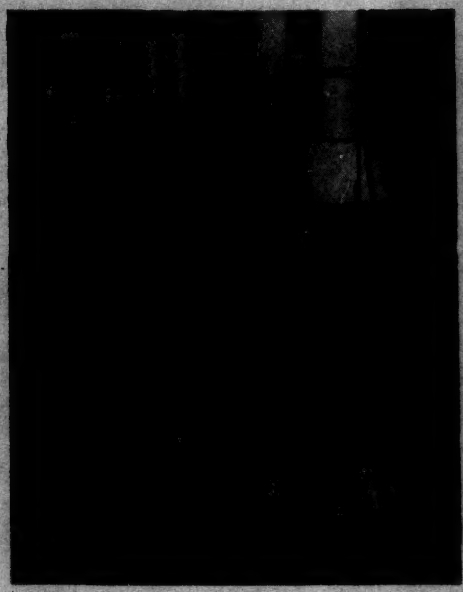
The direct-coupled Carrier centrifugal compressors (see title page illustration) are installed for either parallel or series operation by means of alternate bypass and valve arrangements (see again Fig. 1). In the summer, the compressors operate in parallel on the gas stream and handle a refrigerant flow equivalent to 1650 tons of refrigeration. During this operation, the compressors operate at reduced speed and reduced discharge pressure in order to maintain a minimum flow of steam to the turbine drive.

In winter operation—high steam demand, lower refrigeration demand—the units operate in series at an increase in speed in order to produce a much higher discharge pressure and to consume as much of the available steam for process as possible.

Refrigeration Cycle Direct Ammonia Expansion

The refrigeration cycle at Schmidt's Philadelphia brewery is shown schematically in Fig. 1. Back pressure of ammonia gas to the centrifugals is 25 psig, and 11.3 degrees F. The centrifugals raise the back-pressure to between 50 and 60 psig (in series operation). Reciprocating compressors (Fig. 2) with capacity increased by this back-pressure boost, take the gas and discharge superheated ammonia gas at 185 psig.

Hot gas is desuperheated and condensed in a high-pressure ammonia condenser, using water from a rooftop cooling tower. The ammonia liquid is then carried throughout the sys-



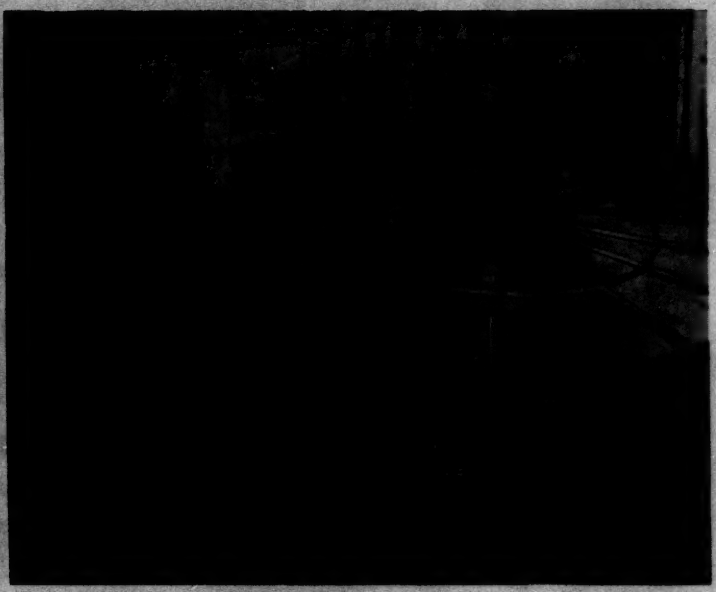


Fig. 2—Left: To meet expanding refrigeration needs, the addition of one or more reciprocating compressors to their existing battery of synchronous motor driven units (six) would have presented both a space and power problem to Schmidt's engineers. Steam-powered centrifugals, acting as super-chargers, provided the solution by boosting back-pressure, and therefore the weight low and tonnage capacity, of reciprocating machines. Fig. 3—Right: After washing, filling, and crowning, conveyorized bottles are then pasteurized, above, inspected and labeled. Pasteurizer is one of many operations requiring part of the 1,200,000-lb maximum 24-hr steam demand.

tem, expanded by means of expansion valves through pipe coils, brine tanks, attemperator coils, hot wort coolers, CO_2 liquefiers, etc., to produce refrigeration. Low pressure ammonia vapor returns through accumulator to centrifugals, completing the cycle.

The steam cycle is also shown in the diagram. The major portion of the 65-pound steam is required for the brewhouse (mashing operation for extraction and conversion of starch, and cooking in brew kettles) and for bottling, washing and pasteurization (see Fig. 3). At periods of peak demand, when exhaust steam from the turbine is not sufficient to meet all process requirements, additional

Fig. 4—Left: A complete record and control of steam for its many process uses is provided by this automatic control panel. Where boiler pressure steam was formerly reduced by numerous stations throughout the plant, the back-pressure turbine now permits maximum heat balance by exhausting boiler steam at process pressure. Fig. 5—Right: In air-conditioned cellar, under precisely controlled conditions, cooled wort is fermented in large open barrels. Schmidt's also has huge closed-fermentation tanks, from which CO_2 (carbon dioxide) is collected, purified, and stored for final carbonation of the fermented beer and ale. Expansion of these facilities would require large areas. Space conserved in the engine-room when adding elsewhere in the brewery provides more "pay-load".

steam from the boiler units is bypassed through reducing valves to the low-pressure turbine side.

Steam Generating

Complementing the economy of steam-powered refrigeration is the boiler system itself. The boilers are designed to burn either oil, pulverized coal, or gas, to take advantage of relative prices and seasonal cost fluctuations. (See Fig. 4 for steam plant recorder-controller panel board).

Built into the Schmidt system are recorder devices and automatic controls to regulate refrigeration capacity so that manual adjustments are kept to a minimum. The automatic controls increase and decrease output of centrifugals to hold a constant ammonia suction pressure on the brewery; 65 psig. process steam needed at such stations as brewing or pasteurizing (see Fig. 4), is held constant as previously indicated by supplementing centrifugal exhaust with boiler steam.

Installation of the Carrier centrifugal compressor has led to an overall reduction in the number of reciprocating units needed in operation. Of the brewery's six reciprocating compressors, two are operated at low loads, and never more than five on highest demands, thus always leaving one for a spare in event of emergency shutdown or maintenance and repair.

Low Maintenance Factor

With its absence of valves, pistons, and cylinders, the centrifugal compressor requires a minimum of maintenance, and is normally expected to run from 5 to 10 years without repair. Having but one major moving part—a precision balanced rotor—the unit is vibration-free, requiring no special, heavy foundation. Conventional reciprocating compressor requires at least two to three times the floor space of a centrifugal unit of equal capacity. A further advantage, was that the centrifugal's isolated journal bearings prevent oil from being introduced into the gas stream, a problem encountered with Schmidt's reciprocating equipment. Oil in the system has filmed pipes and coils, interfered with heat transfer.

All Centrifugal Plant Ultimate Aim

An important long-range factor in Schmidt's decision to utilize steam-powered centrifugal compressors was that the installation also represents the first "building block" for conversion to an all-centrifugal system when reciprocating machines must be replaced. Such conversion, even if accompanied by further expansion of brewery output (see Fig. 5), will easily be accommodated in the present refrigerating room.

Centrifugal compressors, besides the booster-type application at Schmidt's, can also, of course, be used in parallel with existing direct-expansion reciprocating systems. Or ammonia-condensing centrifugal refrigeration machines can be combined with compression systems, using the centrifugal refrigeration unit to carry the bulk of the load, with reciprocating machines in operation only during peak loads. In this latter system, the ammonia vapor passes through the cooler of the refrigerating unit, and is condensed and liquefied without any appreciable change in pressure.

The brewery's existing system will consequently determine the mehod by which centrifugal compressors can best be utilized. But the installation at C. Schmidt and Sons, Inc.—steam turbine as reducing valve, centrifugals as "superchargers"—points up the basic advantages of centrifugal refrigeration: fuel saving[2] through optimum, economical heat balance; compact, space-saving arrangement; automatic adjustment to load variations; and long life with minimum maintenance.

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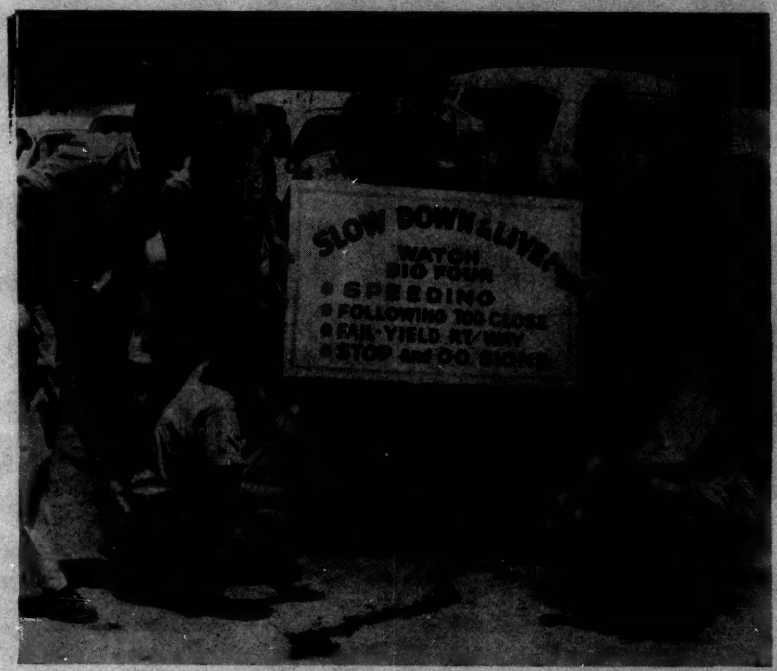
[2]See "Reduce Power, Fuel and Water Costs; M. E. Bell, National Director, NAPRE; INDUSTRIAL REFRIGERATION, September 1957.

Meeting for Ice Truck Drivers Based On Four Safety Pointers

A MEETING on traffic safety for truck drivers at the Ice Department of The Southland Corporation was held at Waco, Texas recently. These drivers have many months of truck operation, with no chargeable accidents. Contributing to this record the company garage and repair shop keeps the trucks in good operating condition. Under the safety conscious guidance of Wiley Wesson the plant manager, the drivers are doing a commendable job in this growing area where the traffic gets worse all the time.

Safety Program Organized

To meet this condition, a well organized safety program has been organized. The most recent traffic meeting was entitled "Slow down and live—Watch the Big Four". The Big Four referred to are shown on poster in the picture: 1—Speeding. 2—Following too close. 3—Fail to yield right-of-way. 4—Stop and go signs. In charge of the meeting was W. F. Leonard, Jr. director of safety for Southland.



Waco Ice Drivers at meeting held by Safety Department.

Booster System

Helps Meat Packer Cut Expansion Costs

CARL FALTER

Plant Supt., Falter Packing Co.

FALTER Packing Co. found itself with a building and refrigeration problem on its hands similar to that of other medium-sized meat packers, when they started a recent plant expansion. The expansion was the second major one in 25 years for the Columbus, Ohio firm. Although Falter had always tried to keep methods and equipment as modern as possible, increased production and new processing techniques demanded more space than could be squeezed from the existing building.

Falter, operating in the Columbus area for about 67 years, is a family-owned company, best known for the bacon and ham supplied to the vicinity within 35 miles of the city. In addition, they process bologna, weiners, all types of sausage and 50 different varieties of luncheon loaf meats. Part of the recent expansion was devoted to big equipment for smoking and processing meats; packaging machinery to slice and vacuum-pack bacon and luncheon meats; and low temperature freezing-storage facilities.

Space Added

First problem was to add an adequate amount of space to the older building, without losing centralization for their processing. A long, narrow extension tacked onto the older building would increase traffic congestion and spread the equipment too far for economical operation.

Luckily, the existing building and land made it possible to build an L-shaped extension along two sides of the existing space (See Fig. 1). This gave Falter the necessary 18,000 feet needed, without drastically changing the layout or work-flow of the operation.

In this new addition, the firm had planned to install freezing and freezer storage facilities for bacon, beef and ham. One production problem has been how to handle short runs. Falter does its own slaughtering, and the cost of setting up a killing line for 50 hogs, for example, is almost as much as it is for 250. Stickers, skinners, etc., run costs for small runs to an uneconomical level. The only alternative to feeding the animals and slaughtering on demand, would be to have adequate freezing and storage space for quantities of processed meat that were not required for immediate shipment. This was planned for the new addition.

Call Refrigeration Experts

With the addition roughed out on paper, Falter turned to its refrigeration consultants. The C. M. Robinson Co., of Columbus, had previously supplied the firm with refrigeration equipment. It was felt that they understood the problems and had the facilities and know-how to properly engineer any new requirements. H. H. Moberly, manager of Robinson, sat down with Falter's owners, production management and engineers, to plan the most efficient way of installing the new facilities.

Engine Room Location Posed Distance Problem

First problem was a 300-foot distance from the space allotted for the low temperature room to the existing compressor room. The problem of lowered efficiency in long lines and the necessity for increased compressor capacity were carefully considered.

In the compressor room, located at the back of the older building, were four reciprocating compressors of 75, 60, 50 and 40 hp in an NH_3 system which was designed to operate at 20 psig or about 5F. By operating these in pairs, engineering was able to maintain a refrigerating capacity of about 70 tons, and minimize the amount of maintenance and downtime lost on the equipment.

The low temperature room, however, being such a long distance from the compressors, and requiring a room temperature of from minus 10F., could not be handled with the existing compressors. This meant adding additional capacity to the system. The compressor room was already well-filled, and to continue alternate operation practice, two more compressors would be required to handle the new load.

This type of expense, on top of the cost of building the new addition, might have made the low temperature room prohibitive to install. Heavy-duty liquid and suction lines running the 300 feet to the new space was another strong consideration in planning the system.

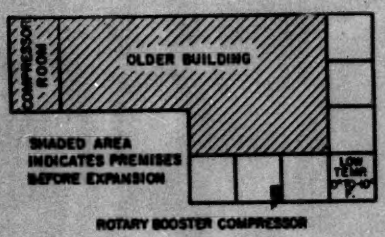


Fig. 1—Seven cubicles arranged in L-fashion indicate position of new additions to Falter Packing Co. plant at Columbus, Ohio. Note distance (300 feet) from rotary and low temperature room to the new engine room.

Moberly suggested that Falter try another approach to the problem. Rather than installing more compressor capacity and extending the house lines to the new addition, he drew up plans for a separate booster system and smaller piping which would directly serve the low temperature room without changing the load on the existing system. Best of all, the new system cost 40% less than a compressor installed in the standard single-stage system.

His plans for the system included a 7-1/2 hp. FES-Fuller rotary booster, supplied by Freezing Equipment Sales, Inc., York, Pa., plus an intercooler and the necessary connecting piping. The rotary was installed to discharge through an intercooler and then into the main house suction line which was already located about 40 feet from the proposed site of the rotary. To complete the piping hookup, a suction line was run from two unit coolers in the low temperature storage room and connected to the rotary. Liquid refrigerant for the unit coolers was available from the existing liquid line which was already installed for the main plant refrigeration system.

Refrigerant piping offered a definite saving with the proposed system. The regular liquid line running through the older building was 3/4-in. The main house suction line was a 4-in. pipe. By installing the booster, the liquid line could tapped for a 1/2-in. pipe to the low temperature room, and the discharge line that feeds back into the house suction line would be only 1-1/4-in. For an isometric view of the hookup, together with line sizes, see Fig. 2.

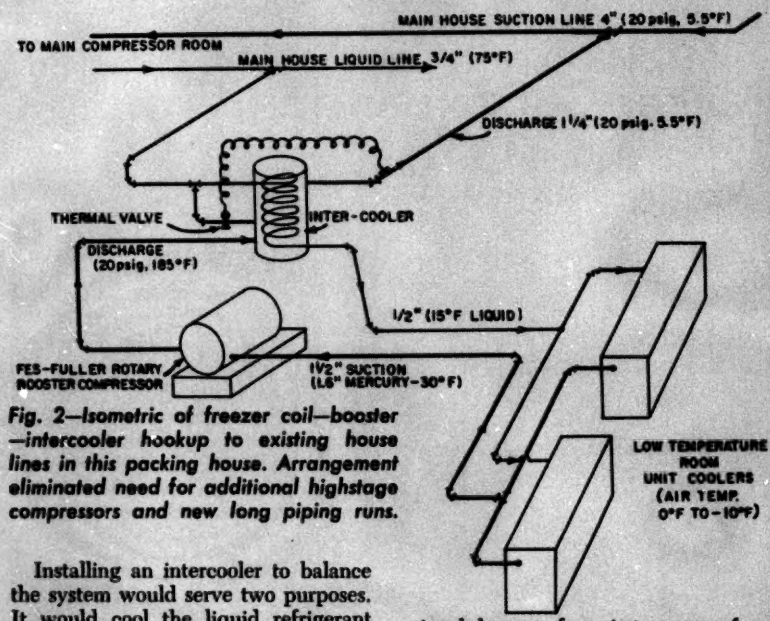

MAIN HOUSE SUCTION LINE 4" (20 psig, 5.5°F)
TO MAIN COMPRESSOR ROOM
MAIN HOUSE LIQUID LINE, 3/4" (75°F)
DISCHARGE 1 1/4" (20 psig, 5.5°F)
THERMAL VALVE
INTER-COOLER
DISCHARGE (20 psig, 185°F)
1/2" (15°F LIQUID)
FES-FULLER ROTARY BOOSTER COMPRESSOR
1 1/2" SUCTION (16" MERCURY-30°F)
LOW TEMPERATURE ROOM UNIT COOLERS (AIR TEMP. 0°F TO -10°F)

Fig. 2—Isometric of freezer coil—booster—intercooler hookup to existing house lines in this packing house. Arrangement eliminated need for additional highstage compressors and new long piping runs.

Installing an intercooler to balance the system would serve two purposes. It would cool the liquid refrigerant on its way to the low temperature room's cocling coils; and, lower the temperature of the super-heated discharge gas from the rotary compressor, so it may be returned to the main house suction line at a matching temperature and pressure. This was done by expanding part of the refrigerant liquid into the intercooler shell through a thermal valve—(see again Fig. 2).

The simplicity of the FES-Fuller rotary also appealed to Falter's maintenance staff, and an alternate or standby compressor was not considered necessary. The absence of valves, connecting rods and pistons would permit them to overhaul the unit and have it back in operation in about half a day.

Popular With Maintenance

With light-weight, small-size and lack of pulsation, the foundation necessary for the rotary was small. It was installed with related equipment about 60 feet from the low temperature room, in an easily spared corner of ordinary storage space (see Fig. 3). One of the obvious advantages of the new system was the fact that the compressor has a low wear and maintenance rate, and would not be a maintenance problem.

The entire installation of the booster compressor unit cost about $3,700, including piping. The cost of another reciprocating compressor (and this would not allow two units for alternating operation, which is recommended) would have cost over $6,000., without the refrigerant piping. This factor alone brought about the decision on the rotary compressor, but the firm feels it may have an additional bonus of maintenance-free operation. The FES-Fuller rotary compressor has been operating since installation with no shut-downs and with no need to perform other than routine maintenance.

Operation of the system is completely automatic. The compressor operates only on demand. Therefore, electric bills are not substantially changed because a normal starting torque motor is used to drive the unit. Since the blades of the rotary booster do not extend until the compressor is turning over at 30 to 35 percent of its operating speed, starting load is low, and requires less current draw.

How Facilities Operate

Liquid refrigerant flows from the house line at a temperature of 70F. After it passes through the intercooler it reaches the low temperature room's cooling coils at a temperature of 15F., to give highly efficient operation in the unit coolers. The low temperature room is used for freezing bacon, hams and beef, and for maintaining them at low temperature until they are shipped out. This requires air at minus 10F. Two cooling coils provide this temperature.

As the ammonia refrigerant leaves the low temperature room's coils, it

(Continued on Page 68)

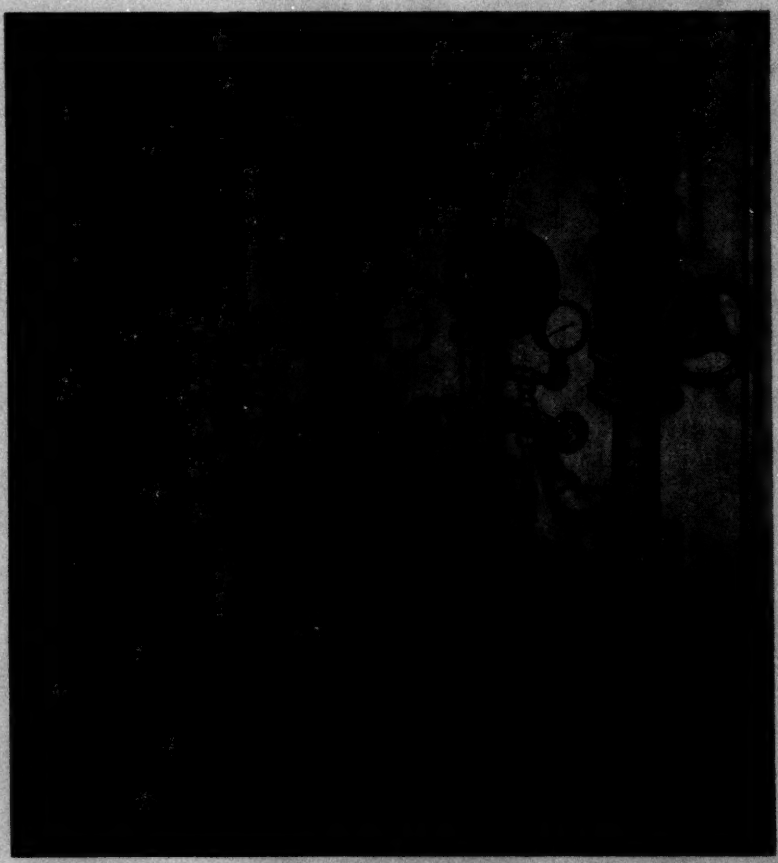
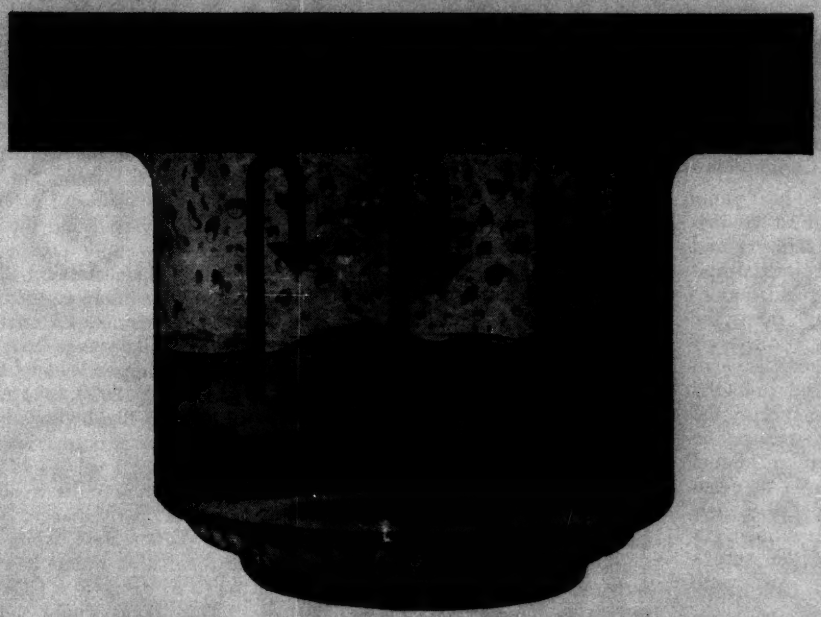


Fig. 3—FES Fuller rotary compressor which was installed in a corner of ordinary storage space about 60 ft. from the new low temperature freezing-storage room.

Some insulations transmit vapor



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From Boilers to Boosters

Air Conditioning with the AIR-SOURCE Compound Heat Pump

SYDNEY M. MINER
Industrial Sales Manager, Central District
York Corporation—Div. of Borg-Warner

FUTURE potential of the heat pump is tremendous. That must be evident to not only manufacturing and operating firms in the industrial and commercial refrigerating field, but to others as well, judging from the growing popular interest in all facets of the subject. International concern over energy resources and publicity on atomic energy as the fuel of the future have made the general public well aware of the importance of fuel conservation. Predictions as to when the world will run out of fossil fuels are rampant. Yet man continues to use as much as 40% of the world's fuel supply inefficiently for space heating.

A recent booklet entitled "Moving Ahead With the Atom" released by Chase Manhattan Bank refers to energy obtained by heat pumps as "Income" energy. The description implies replenishment of this energy by nature as we use it. Conventional energy sources—fossil fuels—are alluded to as "capital" energy, which when once used, are gone forever. A Compound Air-Source Heat Pump has been designed to use up as little "capital" source energy as possible. It gets its main heat from what the bankers have described as "income" energy.

Over the past several years, the heat pump as a subject has been a major drawing card on agendas of almost all technical gatherings. The recent University of Wisconsin Air Conditioning Conference devoted a session to the heat pump. The 1951 Midwest Power Conference carried three papers on heat pump subjects. In one of these papers, the statement was made that solution of the economic problem of electric heating by the heat pump was "still in the development stage". No reference was made to the compound heat pump, since it was yet to come.

Applications of the heat pump principle are numerous and varied. Frozen concentrated orange juice is made with a heat pump in Florida[1]. Heat extracted in the freezing process is used to evaporate or concentrate the fruit in another part of the process. The compound cycle is used.

Single-stage heat pumps—particularly with well water sources—are quite common. Ground coils and solar energy are also sources to consider[2]. For industrial and commercial heating and air conditioning applications, the Compound Air-Source Heat Pump is believed to be economical and justifiable. It offers solutions to many of the problems which have existed and retarded heat pump applications.

Air-Source Heat Pump Cycle

Basic cycle of an air source to water circulating heat pump system is pictured in Fig. 1. Except for the direction of flow, it is readily recognized as a conventional refrigeration cycle. Heat is removed from the outdoor air by means of evaporating refrigerant in the outdoor air cooler unit. Compression system pumps this heat up to a higher temperature level. Here the heat is given up (refrigerant condensed) by heating the circulating water in the summer-winter air conditioning circulating system.

Heat units available to the water are the sum of heat units picked up from the outdoor air plus the heat equivalent of the work input to the compression system. For summer operation, by means of valving, the flow can be reversed and the same conditions will apply except for cooling (picking up heat from) the water and heating the outdoor air.

The conventional refrigeration cycle and single-stage heat pump cycle will use approximately 0.9 Kw (approximately 3000 Btu) input to pick up 12,000 Btu/hr and discharge 15,000 Btu/hr at normal air conditioning temperature levels (+40°F to +105° F). This represents a heating coefficient of performance (COP) of 5. This same system, when operating at extreme heat pump levels (-20°F to +115°F) drops to a COP of about 2.

This alone would not discourage the venturesome soul, since getting 2 Btu out of every 1 Btu in-put sounds like a money-making proposition. But to add to the economic and efficiency difficulties, there are many operating problems which had to be solved: automatic operation and change-over, defrosting, capacity variation and others.

It was in this atmosphere that a refrigeration engineer's approach was made to the problem. For years refrigeration engineers have produced subzero temperatures in ice cream plants and other low temperature applications—continuously, automatically and efficiently—dissipating the heat picked up to any available external sink (well water, outdoor air). Why couldn't the engineer turn that system around, *use similar components*, and capture (pick up) heat from outdoor air and deliver it to a condensing (heat circulating) water system?

After reams of engineering calculations, equipment selections and

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Paper given before the American Power Conference, March 27, 1957, Chicago, Illinois. The author gratefully acknowledges assistance of material assembled by Messrs. R. G. Werden and R. C. Niess of York Corporation.

[1]See, "Refrigeration As Applied To The Concentration of Foods"; Jos. A. Cross; 1953 NAPRE Operating Data Book.

[2]See "Heat Pump and Solar Energy—Their Roles in Space Conditioning"; Dr. R. C. Jordan; Industrial Refrigeration, Sept. 1957, page 25.

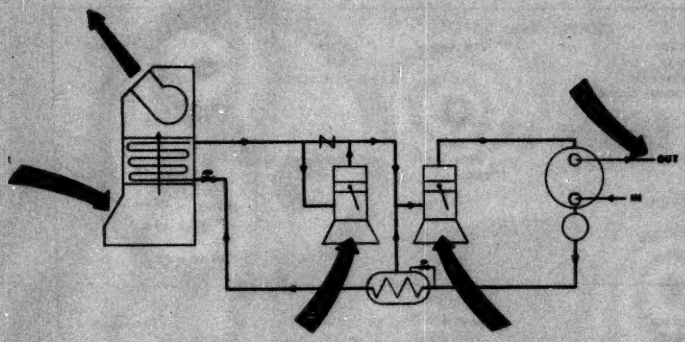


Fig. 1 (above) Schematic of basic heat pump system. Refrigeration engineers will readily recognize elements of their refrigerating system. Minor piping rearrangements could provide for reversal of flow.

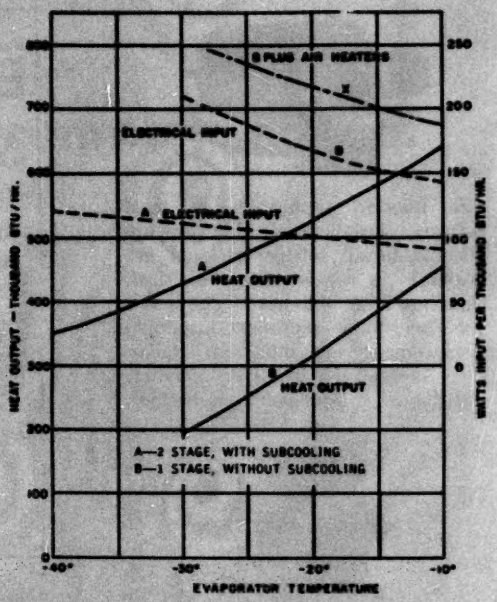


Fig. 2 (right) Comparison of performance features of a single-stage and compound heat pumps. By two-staging, electrical energy demand is reduced and heat output increased.

coordination, control analyses and economic comparisons, that is what has been done. There are two basic secrets to the solution: utilization of the compound cycle for efficiency and use of standard components or equipment for simplicity, ease of maintenance and reliability.

The "Why" Of Two-Staging

The two-stage (compound) cycle is readily recognized in the refrigeration industry. An excellent paper on Booster Operation was published in September 1951[3]. A comparison of operating cycles was given by R. G. Werden in June 1956[4]. Fig. 2 is one of the charts presented by Werden. Curves A represent performance and capacity of a given two-stage equipment selection. Note that at -20F evaporator, there is an output of 520 thousand Btu/hr (MBH) and an input of 100 watts per MBH, a COP of almost 3.

Low Temperature Experiences Applied

Curves B represent the same for single-stage. Note an output of only 315 MBH (40% less heat) and an input of 165 watts per MBH, a COP of approximately 1.8. If, because of other limitations, the *Missing* heat capacity (520-315 MBH) is made up by use of direct electric strip heat, the input would increase to 220 watts per MBH for a COP of 1.3.

The relative sizes of compression equipment required may be viewed in many different ways. Freezer and ice cream plant experience has shown that the same compression displacement capacity may be rearranged to operate multi-stage. Depending on operating conditions and auxiliary equipment, capacities may be identical, but efficiencies will be improved. In actual practice, many plants operate single-stage when compression ratios are low; then convert the same equipment to two-stage when lower evaporator temperatures or higher compression ratios are needed. For a given compressor capacity (displacement) available, and for a given set of operating conditions, equal or more capacity and lower power input can be obtained by operating multi-stage. It becomes only a question of practical and economic considerations: cost and feasibility of multiple machines and piping.

Trade Boilers For Boosters

From another viewpoint, and depending on relative proportions of the heating and cooling cycle loads, only a minimum of additional compressor equipment may be required for the heat pump. The compression equipment available for the summer air conditioning load can usually be used for the high-stage of the heat pump cycle. In fact, under some load conditions, and if increments of compressor capacity can be properly arranged, a portion of the summer compression equipment can be dropped down and utilized for the lower stage as a booster. In any event, the addition of the low-stage, or booster compression equipment is usually done with relatively lower cost compressors. This is due to the lower pressures involved and the advent of high volume, low pressure, lower cost compressors now available. Thus, in essence, we are substituting booster compressors for boiler plants.

The heat pump system is fundamentally right from an overall economic standpoint. It is only necessary that we take advantage of its inherent features by proper design of the system and its components. The economics of multi-stage compression for the low temperature levels which must be reached, are essential.

The Equipment

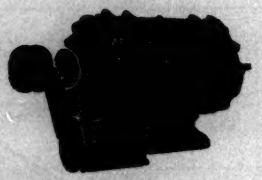
Principal feature of the YORK Compound Air-Source Heat Pump system has been the utilization of standard components. Compression equipment may be any of the readily recognized types—reciprocating, rotary or centrifugal. Choice becomes a question of size, flexibility and cost.

Reciprocating compressors are available from minimum capacities to approximately 150 to 200 ton air conditioning rating in single units. They can handle any of the refrigerants and will usually be used as high-stage machines on most installations except where very large capacities are involved. They may also be used as low-stage (booster) machines, particularly on the smaller capacity installations.

Rotary type compressors have become the standard for low tempera-

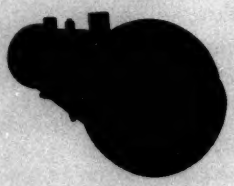
[3]R. E. Miller—"Lets Get Down to Facts on Booster Operation", Refrigerating Engineering, September 1951.

[4]R. G. Werden—"At Last: A Practical Heat Pump", ASRE 52nd Annual Meeting, Cincinnati, Ohio, June 3-6, 1956.



ture booster application in most industrial installations. They are applicable to all refrigerants and are available in a wide range of sizes. Handling large volumes of gas at low pressures, they represent maximum displacement for minimum dollar. They are limited to lower pressures and, hence, to application as booster.

Turbo (Centrifugal) type compressors are now common for a variety of refrigerants and a wide range of capacities. Inherently a high volume compressor, they can cover a wide pressure range by use of multiple compressors or several stages within a given frame. Their usual application will be on extremely large installations where they may be applied as either booster or high-stage compressor.



Although available in a direct air-to-air system, York engineers believe the air-to-water principle is more applicable to larger installations. Thus a close coupled refrigeration system can provide chilled water for summer and hot water for winter. In either case, outdoor air is used as the sink or source to dissipate or obtain heat. Thus a conventional shell and tube type heat exchanger is used for the water heating or cooling medium. Refrigerant valving automatically changes it from one to the other.

The outdoor air unit (winter heat source) can readily be recognized as

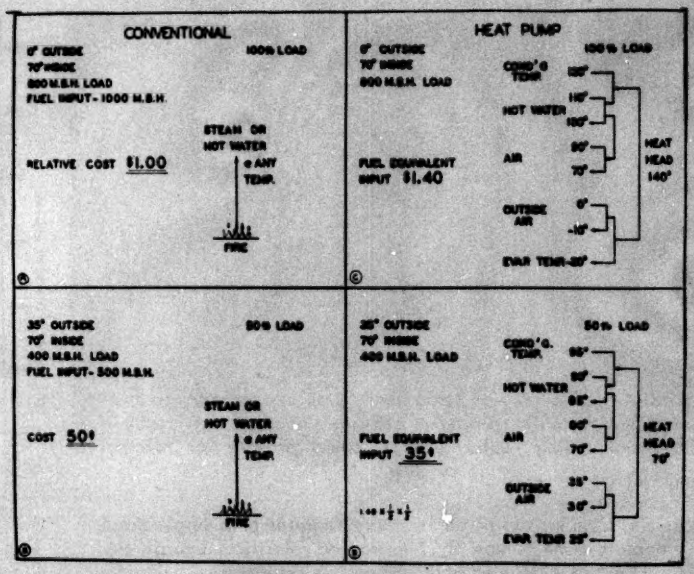
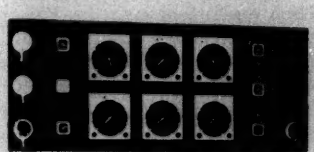


Fig. 3—Diagrammatic presentation of conditions upon which the author makes his basis for fuel-economy comparisons: Conventional heating is represented at left, the heat pump at right; at full and half capacities.

the conventional economizer or evaporative type condenser of an air conditioning system. Because of its multiple function as a condenser on the summer cycle and as an air cooler on the heating cycle, it should be capable of operating either wet or dry. This is nothing new for industrial low temperature air units. Since the two are almost identical—casings and fans are the same—the engineer can take advantage of the heavy-duty type pipe surface in the industrial air unit for wet and dry operation and ease of defrosting. On larger installations, the outdoor air cooler can be built up in the same manner as any industrial low temperature application.



Beside the basic equipment components, the heat pump system is provided with automatic controls for capacity variation, cycle change-over and defrosting. Obviously the outdoor air coolers will collect ice or frost during certain periods of operation. Hot gas thermo-cycle or water defrosting is automatically accomplished when needed.

Economics

A basic concept in analyzing heat pump operating economics lies in recognition of the double influence of temperature levels—and combining this with a careful study of time duration at various temperatures. In addition, slipshod methods of load calculation cannot be afforded. Failure to recognize the influence of modern construction methods, excessive safety factors, ignoring influence of internal heat sources, provision for "warm-up" capacity in a system which operates continuously—all these will bias an economic analysis which must be made carefully in detail.

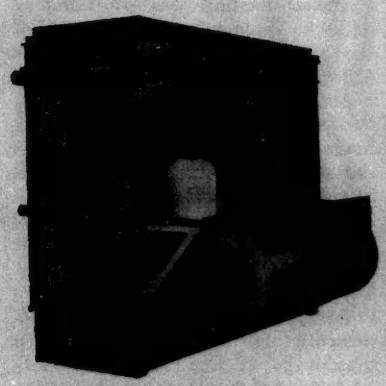
The term "Coefficient of Performance" may cause confusion. It cannot be estimated or used as freely as "Degree Days" or "average burner efficiency". COP at design outdoor conditions is very misleading as the system will operate relatively few hours during the heating season at this condition. A truer analysis can be made by determining system operation at various outdoor temperature levels. Each point of operation must be calculated in detail. This must be extended over a detailed weather analysis and then combined with a careful rate structure calculation.

Energy Utilization

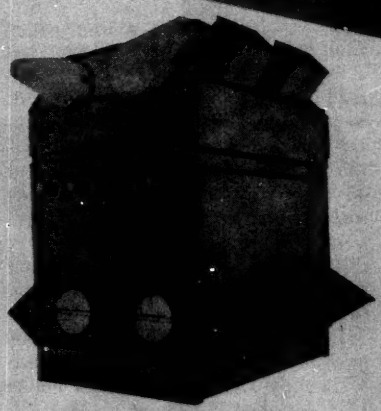
To understand the basic concept refer to Fig. 3. This is not a detailed calculation but rather a schematic description. Section A of the figure sets up the basic conditions. The Btu input would represent 80% burning efficiency—somewhat high, but not of consequence to this analysis. Fuel cost is plausible. Note that temperature levels are unimportant except as to affect on load.

B.A.C.

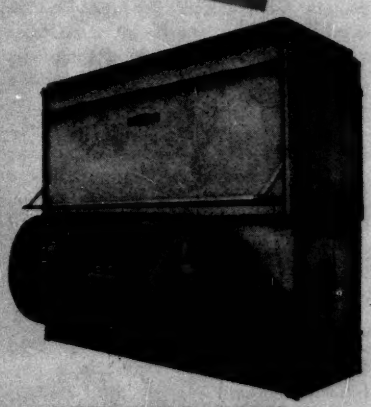
The most complete line of



BLOW-THROUGH
Centrifugal Type



DRAW-THROUGH
Centrifugal Type



BLOW-THROUGH
Propeller Type

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- Low Horsepower (Propeller Fan Units)
- Condensers—Full Weight Steel Pipe Coils
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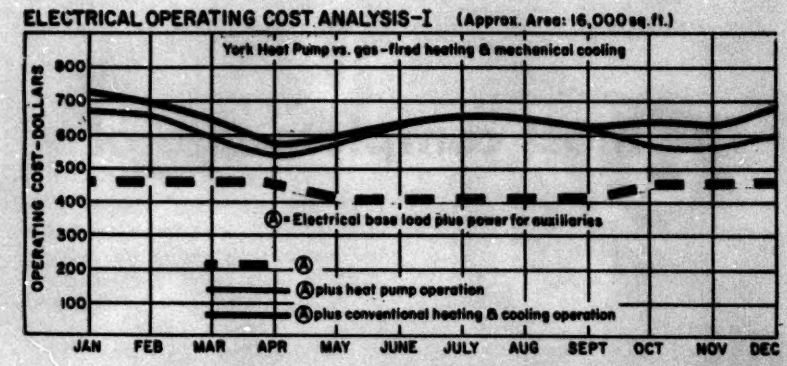


Fig. 4—Graph depicts comparative costs of one conventional system and a heat pump. Note that operating costs of both are "piled upon" the electrical base load of the establishment plus its common power demands for auxiliaries.

Then refer to section B where load was dropped to 50 percent as a result of a 50% rise in outdoor temperature. Depending on boiler burner combination, fuel input will drop to perhaps 50%, but certainly no lower. Note again that temperature levels have no influence except on load.

Next refer to section C, where the same full load condition is taken for Heat Pump operation. Note here that the various temperature levels at which the system will operate are exceedingly important. They establish the "Heat Head" through which the system must operate, which in turn establishes the work input. Dollar value of heat pump input may be higher than fossil fuel on any given job at this condition.

Now refer to Section D for the heat pump at half load. Note the effect of temperature changes on the "Heat Head". Since heat transfer surfaces have not been changed, and since heat transfer is practically linear with temperature difference at constant surface, the temperature levels have been materially changed. The combined affect of reduced load and reduced "head" result in a materially reduced energy input cost.

Detailed Analysis Needed

Noting the overall comparison, it will be seen that the heat pump gains at reduced load (higher temperature levels) and loses at the lower temperature levels. Thus, the frequency of occurance and duration of time at various temperature levels becomes exceedingly important in this analysis. When it is considered that Chicago has a winter design temperature of -10F but an average winter temperature of 35F, it can be seen that a detailed analysis must be made to obtain a realistic picture of system seasonal performance.

Data has been recorded by the U. S. Weather Bureau enabling calculation of number of hours at any temperature level. This data has been computed by us for most major cities across the country. The computations involve starting from degree days month by month for a given area, and working through to determine hours of expected operation over the range of outdoor temperatures. Maximum and minimum temperatures and degree days are recorded for each month.

Some interesting observations come from these analyses. While Boston has a winter design of 0F, the lowest readings in a typical year analysis were 6F in December, 10F in January and 8F in February. Temperature also reached highs of 57 and 45 and 46F in those three months respectively. In January, while there were 36 hours of readings below 15F, there were 114 hours above 36F. In December, there were 36 hours below 15F and 66 hours above 46F.

In Philadelphia, with a design temperature of 0F. the typical month of January had only 12 hours below 15F, but had 24 hours above 56F. In Chicago, with a -10F. design temperature, in the typical December there were only 150 hours below 15F but there were 210 hours above 36F. January did manage to show one -10F. reading. But even in that month there were 138 hours above 36F.

Cost Computations

Starting from the detailed weather data, and after computing system energy requirements over the range of operating condition, the Kw demand and Kwhr consumption is tabulated month by month for the year. This is a lengthy calculation which should be done for the individual job rather than generalizing, for accuracy is desired. System balance—a function of specific equipment—is important when figuring energy consumption on a compound system. Fossil fuel consumption is calculated on the basis of the same heating load calculations and using the Degree-Day method.

The calculations must include separate analysis of base loads (lights and other electric equipment), auxiliary heating and air conditioning equipment (fans, pumps, etc.), summer air conditioning motors and winter heat pump motors. Many of these analyses have been made and results to date would indicate that the heat pump has probably been overlooked on many applications where it would be justified.

Full tabulation of Kw and Kwhr for each month for the heat pump system is matched with the utility rate structure and monthly electric bill estimated. The total is the annual cost of all power for lighting, miscellaneous electric loads, summer air conditioning and winter heating. On one project this was estimated at approximately $7,345. The Kw and Kwhr for the conventional system were estimated at $6,500. Thus, the estimated cost of electric heat pump heating on this job was $1000. Gas for conventional heating was estimated at $1,200. Thus a savings of 20% of the fuel bill was estimated for the Compound heat pump system.

On another job, the corresponding figures indicate a difference in total, annual electric bill of $7,500. This difference represented additional cost of electric heat pump system for heating. Fuel cost, based on No. 5 oil was estimated at $11,000 annually. Thus, a savings of 35% on the heating cost.

Results of calculations on a job presently in operation are shown graphically in Fig. 4. Base electric load is steady at about $470 per month. The slightly higher winter base load is due to continuous operation of fan equipment. Summer operating costs are the same for either system, while the heat pump system shows an operating cost saving throughout the winter months.

Load Factor

In past years most generating plants experienced a total much heavier in winter than in summer. With the advent of widespread air conditioning it is now the summer load that is heavier in many areas. All of this indicates an undesirable imbalance from the utilities viewpoint. Their capital investment in generating plants and distribution lines must be sufficiently large to handle seasonal peaks, whereas they cannot realize sufficient income during "off" seasons.

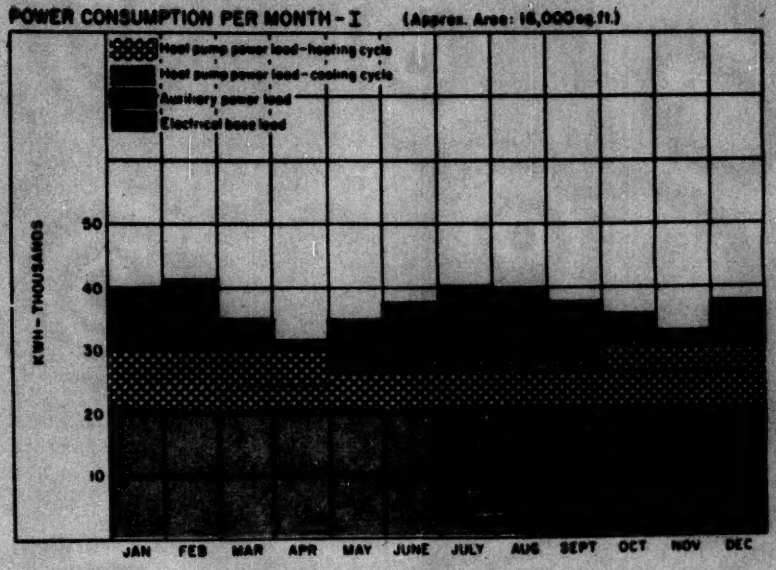


Fig. 5—Levelling off of seasonal peaks is accomplished through use of the heat pump. More uniform consumption of electric power should lead to utility rate considerations.

For these reasons, electric utilities in most locations are favorable toward any development that more closely balances winter and summer demand; one that maintains a more even consumption all year in relation to the peak demand. For example, a recent York air-source heat pump installations showed a winter peak demand 3 percent higher than the summer peak with the minimum demand at 80 percent of the winter peak. Compare this improvement over a conventional installation with gas-fired boiler where the winter demand and minimum demand was 62 percent of the summer peak.

Annual load factor problem is graphically portrayed in Fig. 5 insofar as Kwhr consumption is concerned. Actually, the power company is interested in yearly consumption versus peak demand. On a recent calculation the heat pump system required 445,000 Kwhr against a peak demand of 145 Kw. This represents a usage factor of about 35%. On the same installation, utilizing conventional heating, 141 Kw would have produced 384,000 Kwhr or a usage factor of 31%. Corresponding figures for a 2,000 Kw demand installation in the Chicago area showed a usage factor increase from approximately 40 to 42 percent.

Heat pumps alone will not overcome the imbalance indicated, but do represent a major step in the right direction. From the utility's viewpoint, the annual load factor will usually be improved and will make attractive power rates possible. This, in turn, improves the operating cost comparison of the heat pump with mechanical cooling plus fossil fuel-fired heating boilers in many regions. The utility interest in this situation is self-evident.

Today And The Future

The Air-Source Compound Heat Pump is no longer a theory. There are installations in and operating, and others under construction. Operating data is being accumulated which already indicates the calculations were on the conservative side.

Heironimus Department Store, Roanoke, Va., has a 525 hp heat pump system designed to operate as low as 0F. outdoors with a summer cooling capacity of 312 tons and winter heating load of 2,450 MBH. A completely remodeled building, it has some 160,000 sq. ft. on four floors, mezzanine and basement. Completely automatic in operation, the entire system is mounted on the roof. Factors considered in selecting the system were: (1) Low first cost, (2) Low operating cost, (3) Space saving. Architects and engineers were Hayes, Seay, Mattern & Mattern, of Roanoke, Va.

One of the nation's oldest firms of architects and engineers, the Ballinger Company, installed an Air-Source Compound Heat Pump system last summer for their new home office building in downtown Philadelphia. The two story and partial basement structure of some 16,000 sq. ft. has a 60 ton system, with duplicate compressor for low-stage operation and is pneumatically controlled. The single cycle, is reversed by means of a summer-winter change-over switch. Heat absorbent floor to roof glass is an architectural feature in the building. Concealed ductwork and ceiling diffusers are used in the open areas. Fan coil convector type units provide heating and cooling in perimeter offices.

Other installations under contract include Sunny Hill Coal Co., and the Columbus and Southern building in Ohio. An installation for the Flick Reedy Corporation in Bensenville (Chicago) Illinois will use a 640 ton system to heat and cool over 200,000 sq. ft. of office and precision manufacturing plant area. (To be reported in INDUSTRIAL REFRIGERATION.)

It is becoming apparent that the Air-Source Compound Heat Pump can cool and heat any commercial or industrial structure. It can do this without any supplementary resistance heating, by extracting all of the heat metered from the outdoor air. The only fuel is the electrical input to the compressors. Previously, this seemed practical in moderate climates. Now this equipment is offered for outdoor design temperatures as low as -20F.

The trend in commercial and industrial design will lead toward greater application of the Air Source Compound Heat Pump for these seasons:

(1) Cooling and heating plants for these structures contemplate at least a 15 to 20 year write-off. With a definite upward trend in the cost of fossil fuels, and a relatively level cost curve for electric energy, heat pump plants will show progressively greater savings as time goes on. In addition, energy for the heat pump is calculated on electricity taken from the last block of power consumed, after base load of lighting, etc.

(2) With building costs ever rising, elimination of the stack and reduction in boiler room space become more important.

(3) Boiler rooms and stacks have always presented an aesthetic and dirt problem. Smoke abatement regulations are becoming more and more stringent.

(4) In time, insurance companies must come to recognize the lesser hazard of heat pump systems—no combustion or products of combustion.

(5) Traffic planning in crowded metropolitan areas is aided by use of heat pump systems. The familiar, but unsightly and inefficient, sight of fuel delivery trucks is eliminated.

(Continued on page 68)

Los Angeles Warehouse Company Announces 20 Million Pound Capacity Warehouse

THE Los Angeles Cold Storage Company, wholly owned subsidiary of California Consumers Corporation, packers of Prime Froz-n brand fruits and vegetables on August 5 began initial foundation work on its $1,500,000 refrigerated warehouse at the site of the old Union Station at 4th and Central, downtown Los Angeles.

"Sidewalk superintendents" watched while two miles of special subterranean heating coils were installed followed by the first loads of a mountain of dirt fill (16,000 cubic yards). The dirt fill will elevate the ground floor of the refrigerated warehouse to the loading level of modern trucks and railroad cars, thus insuring easy and efficient handling of merchandise.

Designed by Vincent Palmer and Associated Architects & Engineers the new refrigerated warehouse will consolidate services now performed in several locations by the Los Angeles Cold Storage Company.

Buildings will cover 135,000 square feet of the 248,000 square foot site. Refrigerated warehouse space will occupy the major portion of the building area with the remainder devoted to offices and dock space. Truck and railroad facilities, parking area and landscaping will blend with the buildings to form an attractive public warehousing center.

Architectural drawing of the planned 20 million pound capacity refrigerated warehouse construction project of the Los Angeles Cold Storage Company. It illustrates the close proximity to the famed Los Angeles City Hall, which is the hub of rail and highway traffic in Southern California.

Improved Customer Service is Keynote

Improved customer service is the keynote of the entire construction project. California Consumers Corporation invested over two years research and study to "put together" what is characterized as the finest refrigerated warehouse facility at this centrally located site.

The new Los Angeles Cold Storage Company public warehouse will be completed about April, 1958. It will be a valuable addition to the "renaissance" of the long dormant old Union Depot Tract.

Refrigerated Storage for Rubber Accessories

REFRIGERATED storage of rubber accessories and supplies used in Southwest agriculture, mining and industrial ventures, evidently pays off. For storage of its stock of rubber belting, hose, tape and other supplies affected by heat, the Garrett Supply Company, Phoenix, Ariz., has moved into new air conditioned office and warehouse quarters. The new one-story concrete and brick building contains 25,000 square feet of floor area.

Three 15-ton refrigeration units supply more than comfort to warehouse personnel. Refrigeration of warehouse air supply, with provision to control dust and humidity, enables the firm to stock a large inventory without risk of deterioration. The warehouse cooling system which provides for temperature control within a one-degree range, offers a big advantage to the firm in safe storage for its stock of products affected by high temperatures.

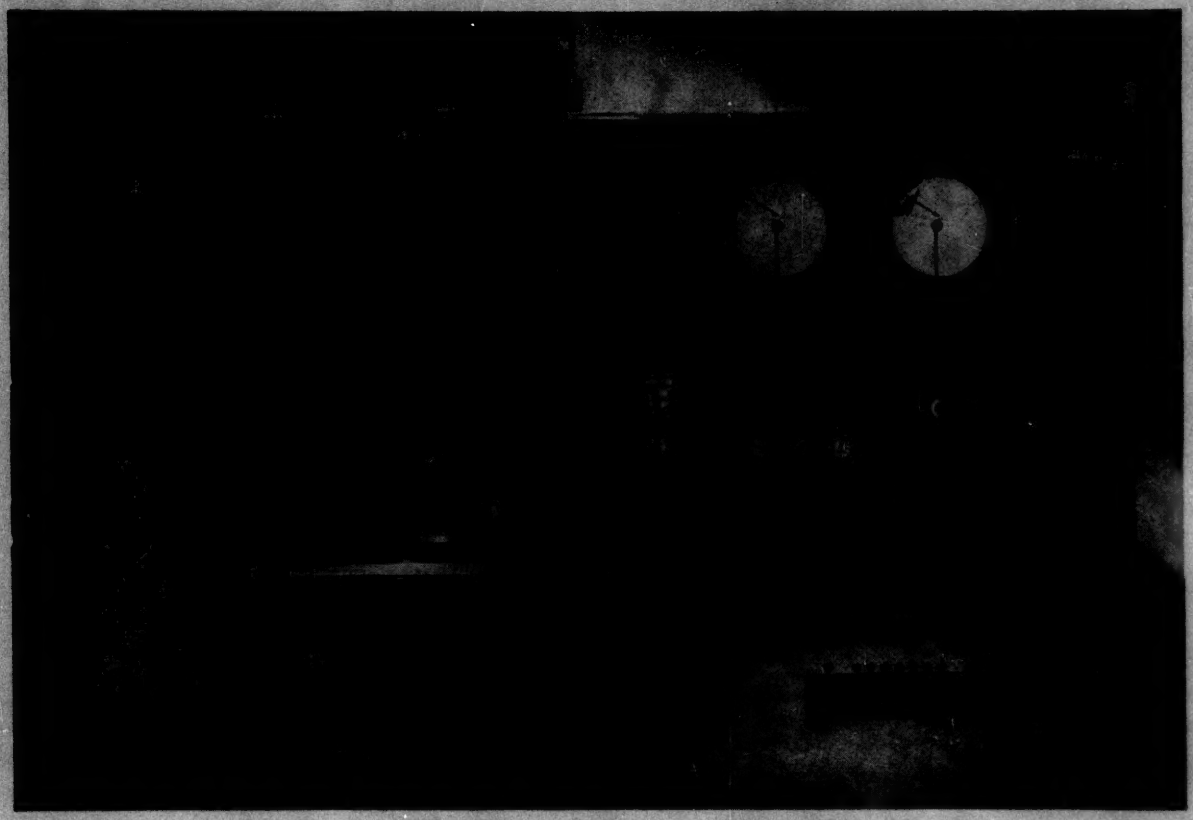
The new building, on 29th Drive and West Thomas Road, is three times larger than the space formerly leased by the firm. Garrett Supply has owned the Phoenix tool and supply firm since 1954, when McConkey-Docker and Company, founded in 1913, was purchased by The Garrett Corporation. The company sells industrial, mining and agricultural tools and supplies.

Turkey Plant Expanded

EXPANSION now under way by the Nephi Processing Company, Nephi, Utah will enable the firm to process up to 4.5 million turkeys this year, Co-owners Milton L. Harmon and Earl H. Steele announced. The new block building will contain a 125 by 60-foot fully refrigerated cold storage room, a dry storage room and a machine room.

The Nephi Processing Company has grown rapidly since it was organized in 1953. It now operates its own hatcheries, two at Nephi and one at St. George. Mr. Steele said that the Nephi Processing Company is the only one in Utah and among only four in the United States that uses the brine-freeze method of packing. Birds processed at the Nephi plant carry the "Pride of Utah" label and are cellophane-packaged, ready for the oven.

In previous years the turkeys have had to be shipped to market immediately. The new storage building means the firm may now hold its product indefinitely.



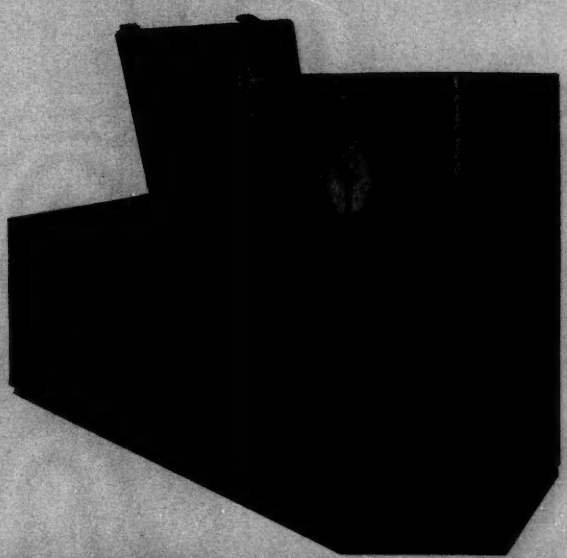
How Taylor Instruments help Bausch & Lomb Go up to 80,000 ft... Go down to −100°F.

ABOVE... and at right... you see a part of what scientists at world-famous Bausch & Lomb Optical Co., Rochester, N. Y., call their "Dive and Climb Lab", formally known as the Environmental Testing Laboratory. There optical components and equipment for military and commercial use are tested to determine their suitability for jungle service, high-altitude flying, thermal shock, mechanical shock, vibration and corrosion.

In the test chamber at top, equipment can be subjected to pressures as low as those met at 80,000 feet, to temperatures from minus 100° to +250°F. and to humidities from 18% to 95% within temperatures from 50° to 150°F. The Low Temperature Chamber, (right) located directly opposite the one described above, can go as low as −100°F. Their close proximity affords convenient thermal-shock test facilities.

These "Dive and Climb labs", made by Conrad, Inc., Holland, Michigan, are equipped with Taylor Instruments. Above are a Taylor Pressure Controller with a split scale the equivalent of 100,000 ft. and 30" of mercury, and a Taylor Electronic Contact Wet-and-Dry Bulb Controller. On the Low Temperature Chamber at right is another Electronic Temperature Controller.

If you have a problem of control or measurement, call on the company the specialists call on . . . Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada.



Taylor Instruments MEAN ACCURACY FIRST

WHY KRAMER THERMOBANK MAKES ¢ENTS

... it costs less to buy and less to operate

When buying a low temperature system compare the total cost of all equipment including the coils, compressor and controls and you will find that...

THERMOBANK SAVES DOLLARS ON COMPRESSOR COST
It uses a smaller horsepower compressor than all other systems for the same capacity; because only THERMOBANK can use a low temperature compressor without overloading the compressor motor.

THERMOBANK PRICE INCLUDES ALL PARTS
It is complete; no extras to buy. Competitive systems require extras such as electric heaters, hand valves, electric lines, controls, insulation, etc.

ONLY THERMOBANK ELIMINATES LIQUID DAMAGE
It provides an abundance of heat for positive liquid re-evaporation during defrost. Systems that depend on heat of compression as source of heat will circulate liquid. Liquid slugging results in progressive compressor damage and expensive repairs.

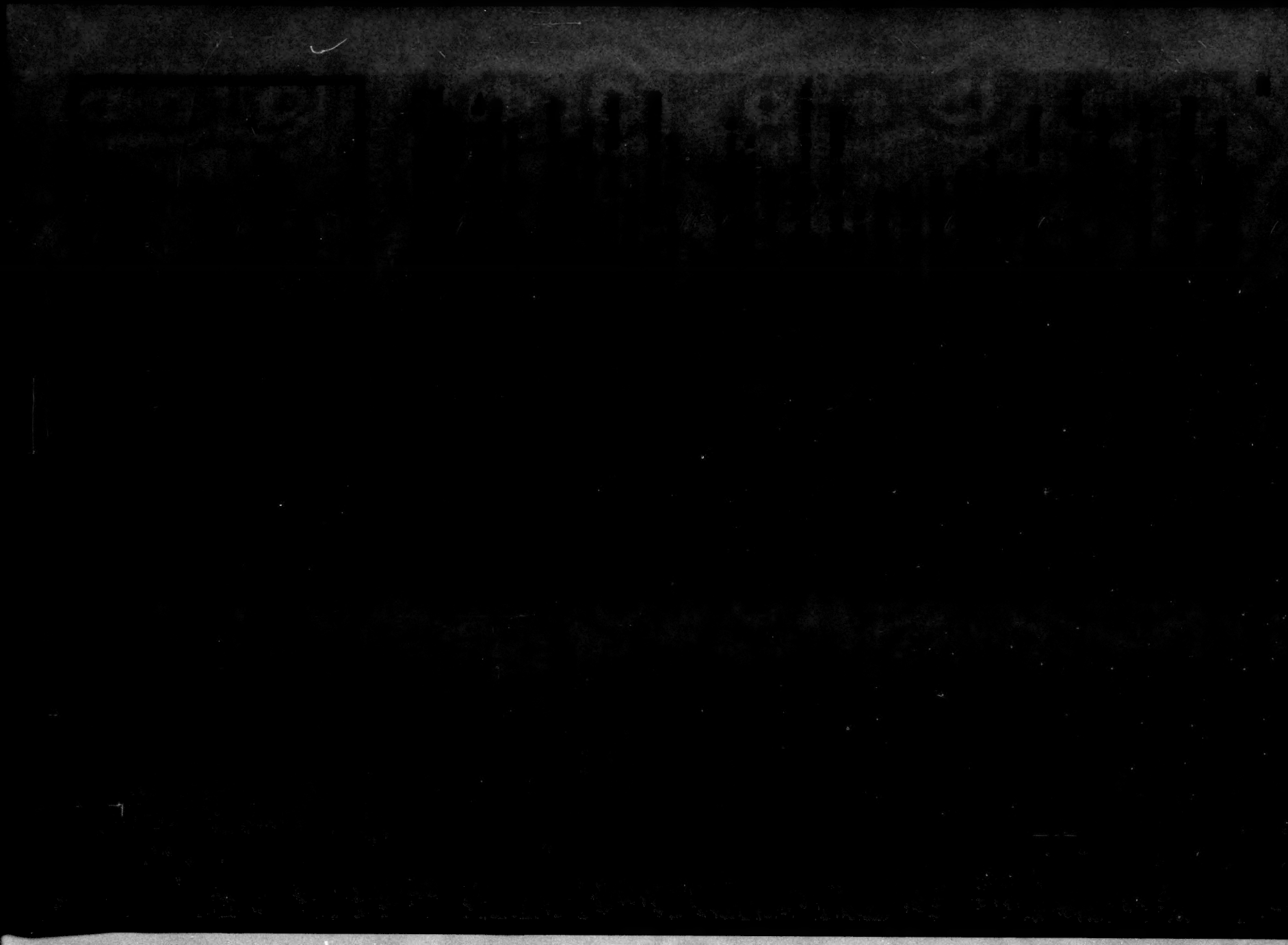
ONLY THERMOBANK PREVENTS LUBRICATION FAILURES
With THERMOBANK oil stays in the crankcase. All other systems have a sharp reduction in suction pressure after defrosting, causing oil foaming and oil pumping, exposing the compressor to lubrication failures.

THERMOBANK COSTS LESS TO OPERATE
It uses less electricity and operates fewer hours. Only THERMOBANK automatically regulates defrosting based on frost buildup and eliminates unnecessary defrosting cycles. It defrosts at any outdoor temperature and is very fast (all other systems require three to four times longer to defrost).

ACTUAL USE PROVES THERMOBANK IS TROUBLE-FREE
THERMOBANK is the oldest and the only time-proven system that can assure an owner trouble-free operation without continual threat of system failure and loss of expensive frozen food.

WRITE FOR AVAILABLE LITERATURE

KRAMER TRENTON COMPANY
Trenton 5, New Jersey
44 YEARS OF CONTINUOUS ACHIEVEMENT IN HEAT TRANSFER



[illegible]

BRINE PUMPS (See Pumps by Types)

BRINE SPRAYING SYSTEMS

BRINE TANKS

[illegible]

BRINE TREATMENT (See Water and Brine Treatment)

CALCIUM CHLORIDE

[illegible]

CAPACITORS (See Electrical Unit Equipment)

CARBON DIOXIDE REFRIGERATING SYSTEMS AND COMPONENTS

[illegible]

CARBON DIOXIDE, SOLID CARBONIC ACID REFRIGERATING SYSTEMS

[illegible]

CASINGS, LINER

[illegible]

CEILINGS AND COOLING

[illegible]

CONTROLS, SUCTION PRESSURE ACTUATED

Bailey Meter Co., Cleveland, Ohio.
Detroit Controller, Wilkinson, Conn.
Gas Valve Mfg. Co., A. V., Newark, N. J.
Gorman Company of Anaheim, Anaheim, Ill.
Detroit Controls Corp., Detroit, Mich.
Hallett Corp., Hamilton, O.
Minneapolis-Honeywell Reg. Co., Minneapolis, Minn.
Penn Corp., Chicago, Ill.
Phillips & Co., H. A., Chicago, Ill.
Powers, Inc., Cleveland, Ohio.
Refrigeration Specialties Co., Chicago, Ill.
York Corp., York, Pa.

CONTROLS, TEMPERATURE ACTUATED (See Expansion Valves)

CONVEYORS AND COMPONENTS

Bolted Bins Co., Fort Worth, Texas.
Dodge Manufacturing Corp., Mishawaka, Ind.
Jeffrey Manufacturing Co., Columbus, Ohio.
Link-Belt Co., Chicago, Ill.
Mathews Conveyer Co., Ellwood City, Pa.
Stephens-Adamson Mfg. Co., Aurora, Ill.
Webster Manufacturing, Inc., Tiffin, Ohio.

COOLERS, BRINE (See Brine Coolers and Chillers)

COOLING TOWERS

Ceco Steel Products Corp., Chicago, Ill.
Fluor Products Co., Los Angeles, Calif.
Marley Co., Kansas City, Mo.
Ransome Co., Inc., Dunellen, N. J.
Schutte & Koerting, Philadelphia, Pa.
Wheeler Condenser & Engineering Co., Deepwater, N. J.

CORK INSULATION PRODUCTS (See Insulation)

CORROSION CONTROL (See Protective Coatings)

COUPLINGS (See Drives)

CRANES AND HOISTS

Bolted Bins Co., Fort Worth, Texas.
Jeffrey Manufacturing Co., Columbus, Ohio.
Link-Belt Co., Chicago, Ill.
Mathews Conveyer Co., Ellwood City, Pa.
Stephens-Adamson Mfg. Co., Aurora, Ill.
Webster Manufacturing, Inc., Tiffin, Ohio.

CRANKSHAFTS (See Compressor Parts and Accessories)

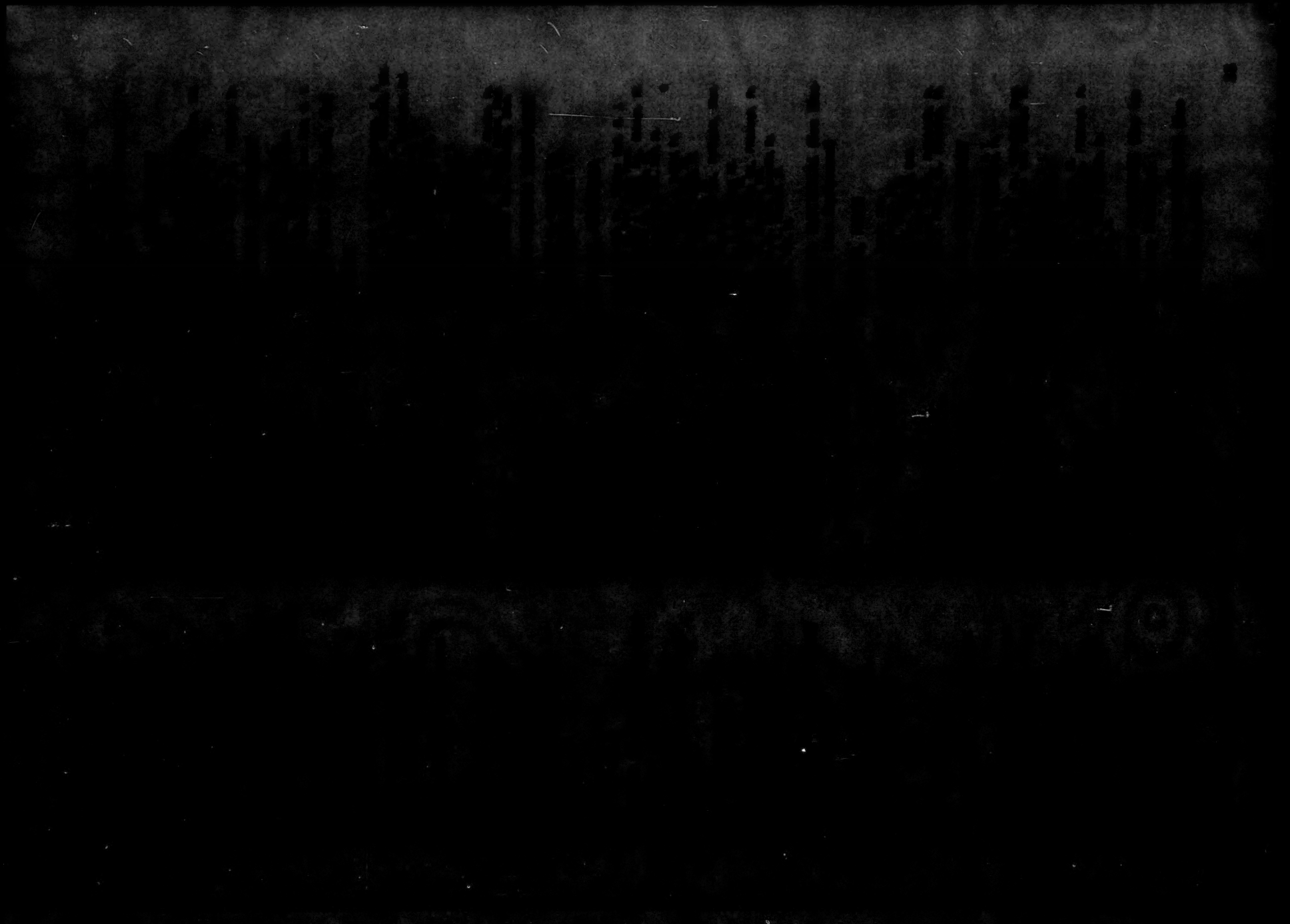
CREAMERY AND DAIRY MACHINERY (See Dairy Equipment)

DAIRY EQUIPMENT

Creamery Package Mfg. Co., Chicago, Ill.
Hoffman & Son Co., Chas., Franklin, N. Y.
Mojonnier Bros., Chicago, Ill.
Mueller Co., Decatur, Ill.

DAMPER MOTORS AND REGULATORS

Bailey Meter Co., Cleveland, Ohio.



FLEXIBLE COUPLINGS (See Drives and Couplings)

FLOATS, CONTROLS, SWITCHES (See Controls)

FLOAT VALVES (See Controls, Float Valves)

FLOORING MATERIALS

FLOW CONTROLS (See Regulators, Flow)

FOIL, METALLIC

FOOD FREEZING EQUIPMENT (See Freezers, etc.)

FOOD PROCESSING MACHINERY

FORK LIFT TRUCKS (See Materials Handling Equipment)

FREEZER DOORS (See Doors, Cold Storage)

FREEZERS, BATCH, BLAST, CONTINUOUS, PACKAGE, QUICK, SHARP, TUNNEL, PORTABLE

FREEZERS, ICE CREAM (See Ice Cream Freezers)

FREEZING SYSTEMS

FREEZING TANKS (See also Brine Tanks)

[illegible]

INSULATION ACCESSORIES

[illegible]

INSULATION ADHESIVES (See Adhesives, Cements, etc.)

INSULATION FINISHES (See Adhesives, Cements, Compounds, Coatings)

INSULATION REFLECTIVE

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INSULATION, THERMAL HIGH TEMPERATURE

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INSULATION, THERMAL LOW TEMPERATURE

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INSULATION, THERMAL: LOW TEMPERATURE, POURED, FITTINGS, PIPE COVERINGS

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INSURANCE

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[illegible]

LIQUID INDICATORS

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LIQUID LEVEL [illegible] (See Gauges, Liquid Level)

LIQUID RECIRCULATING [illegible]

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LIQUID SEALED PUMPS

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LITERATURE [illegible]

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LOW TEMPERATURE [illegible] CASINGS

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LUBRICANTS, [illegible] OIL

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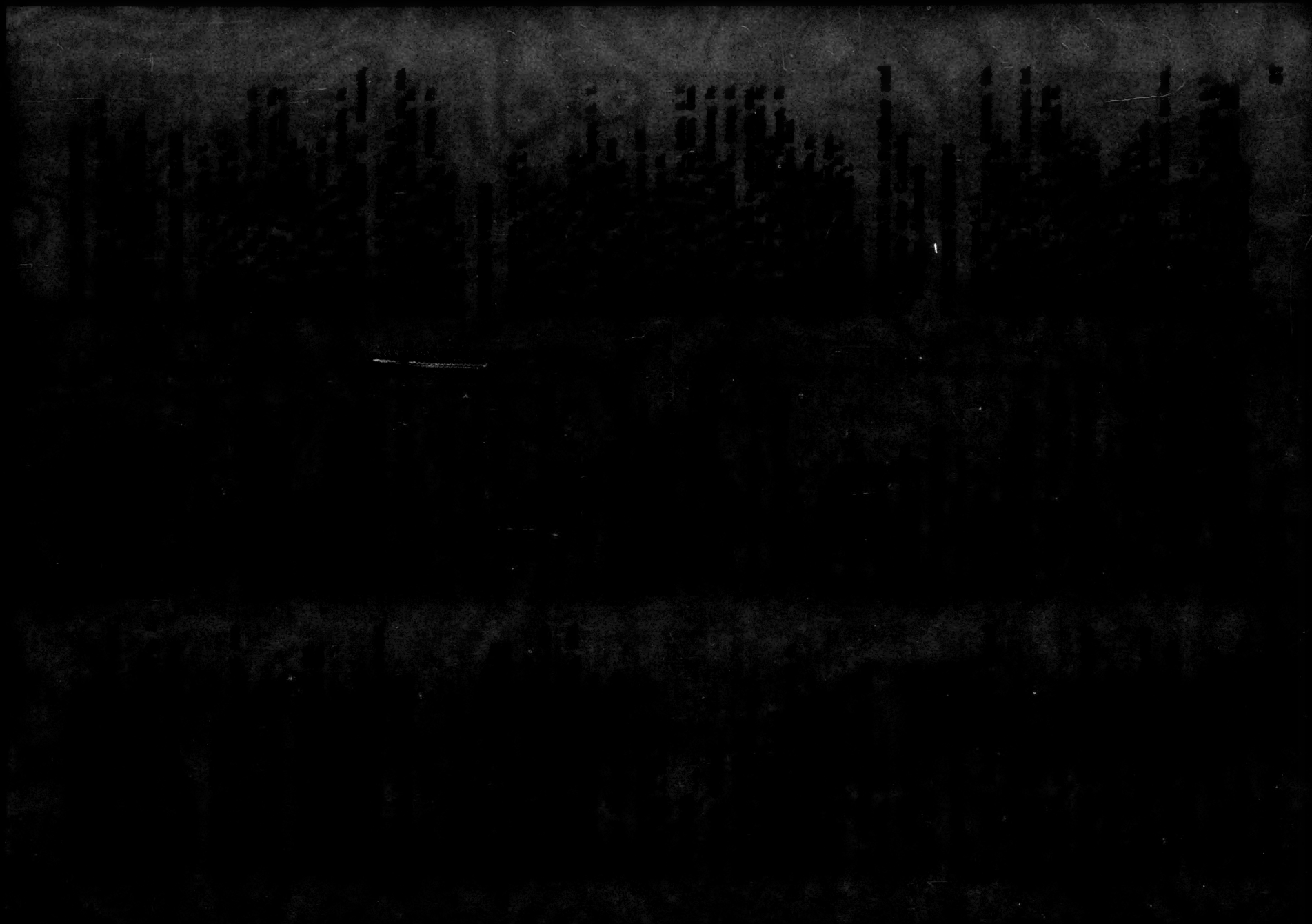


PROMOTIVE DEVICES

PSYCHROMETERS (See Instruments, Indicating & Recording)

PULLEYS (See Drives & Couplings)

PUMP VALVES (See Valves, Pump)

PUMPS (See Types as listed below)

PUMPS, ACCESSORIES AND PARTS

PUMPS, AIR

PUMPS, AMMONIA

PUMPS, BRINE

PUMPS, CENTRIFUGAL

PUMPS, DEEP WELL

PUMPS, GEAR

PUMPS, GEARED

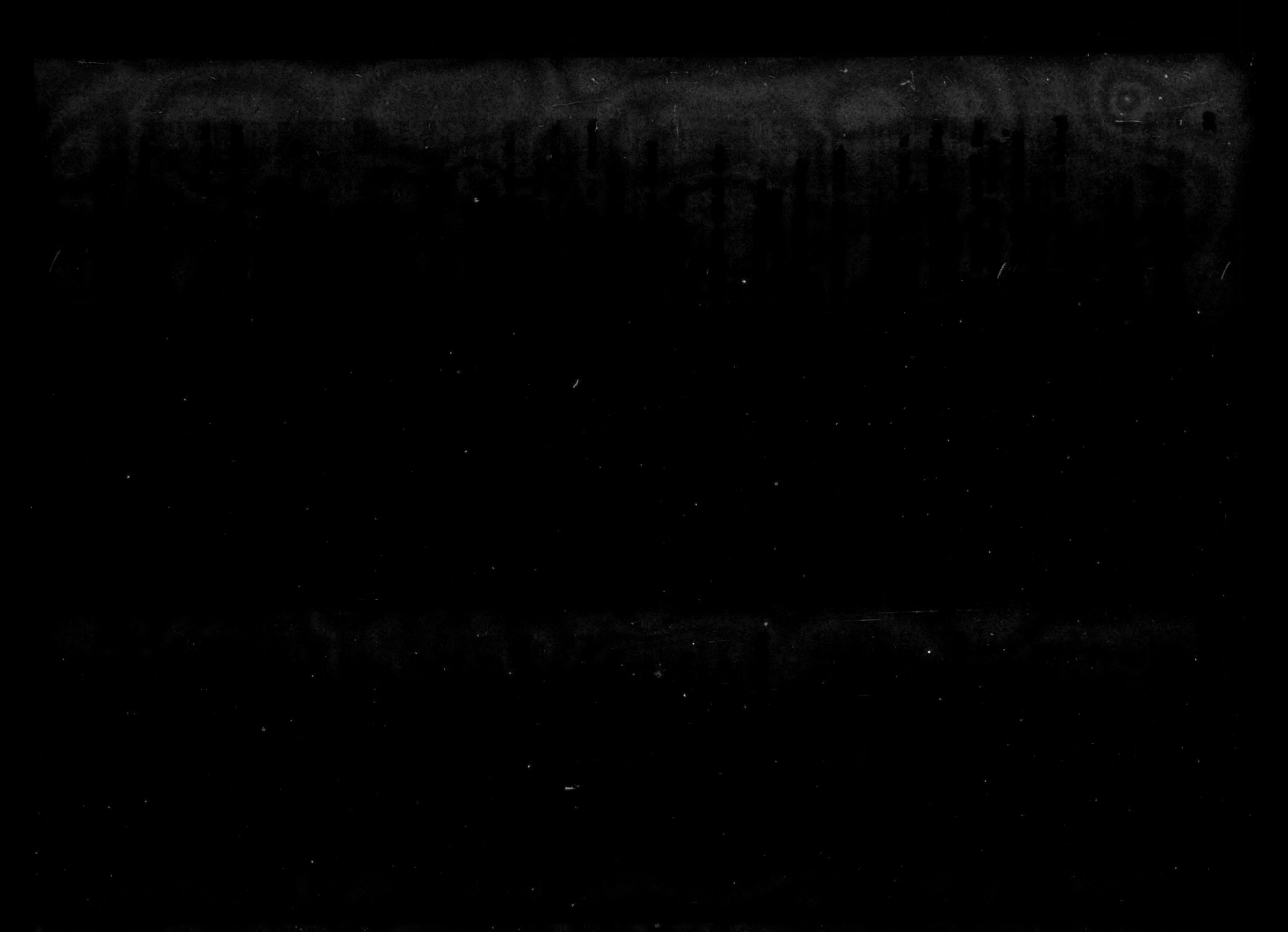
PUMPS, HAND

PUMPS, VACUUM

PUMPING, Automatic

PUMPING, Oil (See also Oil)

PUMPING, Water (See also Water)



STRAINERS, AIR, OIL, STEAM, WATER

STRAINERS, REFRIGERANT

STYROFOAM (See Insulation)

SUCTION PRESSURE REGULATOR (See Valves, Back Pressure)

SULFUR DIOXIDE, ANHYDROUS (See Refrigerants)

SURGE TANKS (See Pressure Vessels)

SWITCHBOARDS

SWITCHES AND CONTROLS

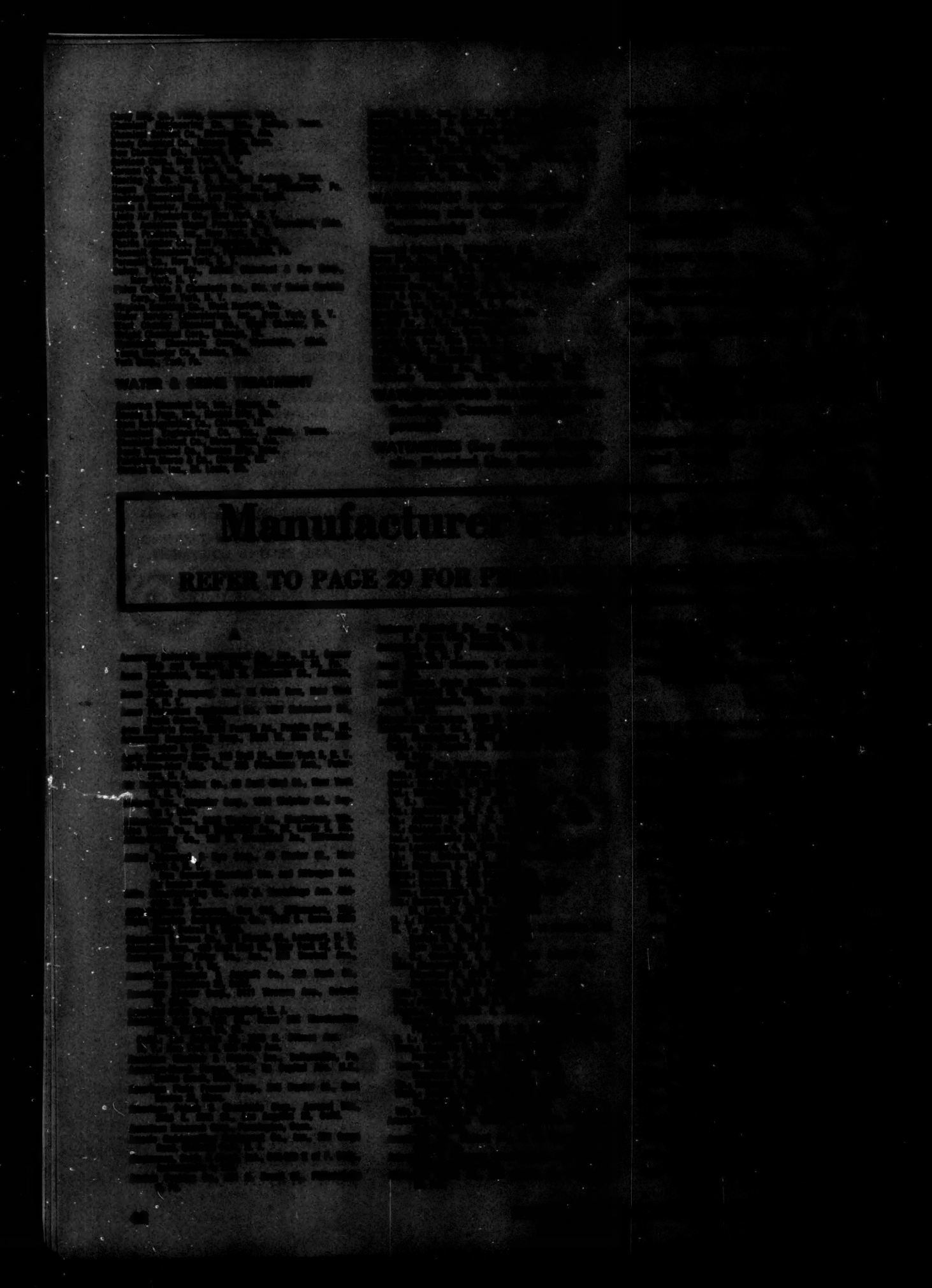
SWITCHES, ELECTRIC (See also controls; also Motor Controls and Starters; also Time Switches)

TACHOMETERS

TANKS (See also Pressure Vessels)

TANKS, SEWAGE (See Sewage Tanks)

TANKS LATENT HEAT



Rotometals, 980 Harrison St., San Francisco 7, Calif.
Royco Instruments, 720 Arthur St., Albany 10, Calif.
Ruggles-Klingemann Mfg. Co., Foster Court, Salem, Mass.
Ruotlede Products Company, 3125 Perkins Av., Cleveland 14, Ohio.
Ruthman Machinery Co., 1900-21 Reading Road, Cincinnati 2, Ohio.

S

Safety Seal Piston Ring Co., P. O. Box 188, Fort Worth 1, Texas.
S&S Vending Machine Co., 670 Lincoln Ave., San Jose, Calif.
Schenectady Mfg. Co., Kittle Road, Holland, Ohio.
Schmidt, Gardon & Erikson, 104 S. Michigan Ave., Chicago, Ill.
Schnacke, Inc., 1101 N. Governor, Evansville 7, Ind.
Schoellkopf Mfg. Co., 312 N. Third St., Madison 3, Wis.
Schutte & Koerting Co., Cornwells Heights Pa.
Serdex Inc., 61 Cambridge St., Boston, 14, Mass.
Shank Company, Cyrus, 4030 W. 12th Place, Chicago 50, Ill.
Sirone, Edward, 3183-39th Ave., San Francisco, Calif.
Skipple Service, 1902 West North Av., Chicago 22, Ill.
Smith, Drummer & Egan, 58 N. LaSalle St., Chicago, Ill.
Smith, James M., 251 Kearney St., San Francisco, Calif.
Snell Inc., Foster D., 29 W. 15th St., New York 11, N. Y.
Solvay Process Division, Allied Chemical & Dye Corp., 61 Broadway, New York 6, N. Y.
Spencer Chemical Co., 610 Dwight Bldg., Kansas City 6, Mo.
Sporlan Valve Co., 7525 Sussex Av., St. Louis 17, Mo.
Sprayline Systems Co., 3201 Randolph St., Bellwood, Ill.
Standard Refrigeration Co., 332 S. Noyes Ave., Chicago 12, Ill.
Star Woolen Co., Cohoes, N. Y.
Sterling Lumber & Supply Co., 11000 S. Halsted St., Chicago 28, Ill.
Stio-Klip Manufacturing Co., 80 Regent St., Cambridge 40, Mass.
Stoebuck, J. W., 84 Burrington St., S.W., Washington 20, D. C.
Stokes Corporation, F. J., 5500 Tabor Rd., Philadelphia 20, Pa.
Stone & Co., Inc., William E., 1330 Dearborn St., Seattle 44, Wash.
Streator Products Corporation, 405 North Depot St., Fairfield, Iowa.
Sun Oil Co., 1608 Walnut St., Philadelphia 3, Pa.
Superior Valve & Fittings Co., 1900 W. Liberty Ave., Pittsburgh 26, Pa.
Surface Combustion Corp., 2376 Dorr St., Toledo 1, Ohio.
Swift & Company, 4115 Packers Av., Chicago 9, Ill.

T

Taco Heaters, Inc., 1160 Cranston St., Cranston 9, R. I.
Taylor Made Ice Vending Mfg. Co., Highway 62, East, Eupora Miss.
La.: Monroe, 1002 Ouachita Bank Bldg.
Taylor Instrument Companies, 95 Ames St., Rochester 1, N. Y.
Temprite Products Corp., East Maple Rd., Birmingham, Mich.
Tenney Engineering, Inc., 1090 Springfield Rd., Union, N. J.
Texas Co., 135 E. 42nd St., New York 17, N. Y.
Thermo King Corporation, 44 South 12th St., Minneapolis 3, Minn.
Thompson Refrigeration Corp., 612 Washington Blvd., Chicago 6, Ill.
Tiderider, Inc., Eastern & Stewart Blvd., Baldwin, N. Y.
Tee-Torr Corporation, 247 Pearl St., N.W., Grand Rapids 2, Mich.
TDT Towers, Inc., 8230 Lawndale, Houston, Texas.
Trane Company, 200 Cameron Ave., LaCrosse, Wis.
Tropical Paint Company, 1340 W. 70th St., Cleveland 2, Ohio.
Tuloroba Company, Inc., 302 E. Locust St., Des Moines 9, Iowa.
Turnbull, Inc., J. Gordon, 3630 Chester Ave., Cleveland, Ohio.
Tuttle & Bailey, Inc., Division of Allied Thermal Corp., 2 9 Warren St., New Britain, Conn.
Ill.: Chicago, 116 Kinzie St.
N. Y.: 420 Lexington Av., Rm. 803.
Pa.: Philadelphia, 902 West Lycoming St.
Typhoon Air Conditioning Co., Div. of Hupp Corp., 239 Carroll St., Brooklyn 18, N. Y.

U

Uehling Instrument Company, 473 Getty Avenue, Paterson 3, N. J.
Union Carbide Chemicals Co., Div. of Union Carbide Corp., 30 E. 42nd St., New York 17, N. Y.
Union Lumber Company, 638 Market St., San Francisco 4, Calif.
United Cork Companies, Kearny, N. J.
U. S. Electrical Motors, Inc., 200 E. Slauson, Los Angeles 54, Calif.
United States Hoffman Corporation, 103 Fourth Ave., New York 3, N. Y.

V

Velocity Power Tool Co., 201 N. Braddock Ave., Pittsburgh 8, Pa.
Vibration Mountings, Inc., 19-20th Ave., Corona 69, N. Y.
Viking Manufacturing Co., 2217 S. First St., Milwaukee 7, Wis.
Ga.: Atlanta, 257 E. Paces Ferry Rd., N.E.
Ill.: Chicago 10, 220 W. Superior St.
Minn.: Minneapolis 2, 2800 Foshay Tower.
Mo.: St. Louis, 1139 Fullerton Bldg.
N. Y.: New York 17, 110 East 42nd St., Rm. 1407.
Ohio: Cincinnati 16, 7305 Vine St., Carthage.
Pa.: Ardmore, 29 W. Lancaster Ave.
Texas: Houston 19, 1 Briar Dale Court.
Virginia Smelting Co., West Norfolk, Va.
Vogt Machine Co., Henry, 1000 West Oroadway St., Louisville, Ky.
Ill.: Chicago, 111 W. Monroe St.
Mo.: St. Louis 17, 6611 Clayton Rd., Suite 200.
N. Y.: New York 4, 80 Broad St.
Ohio: Cleveland 14, 710 Williamson Bldg.
Pa.: Philadelphia 2, 1339 Commercial Trust Bldg.
Texas: Dallas, 311 S. Akard
Voss Co., Inc., J. H. H., 795 E. 144th St., New York 54, N Y.

W

Wagner Electric Corp, 6400 Plymouth Ave., St. Louis 14, Mo.
Warton, Lloyd L., 600 W. 7th St., Spokane 9, Wash.
Water Service Laboratories, Inc., 615 W. 131 St., New York 27, N. Y.
Watkins Co., J. E., 307 Lake St., Maywood, Ill.
Webber Engineering Corp., P. O. Box 217, Indianapolis, Ind.
West Chester Chemical Co., P. O. Box 38, West Chester, Pa.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
Weston Electrical Instrument Corp., 614 Frelinghuysen Av., Newark 5, N. J.
Whitlock Manufacturing Co., 128 South St., Elmwood, West Hartford 10, Conn.
Wichersham Engineering & Construction Inc., J. H., 149 Locust St., Lancaster, Pa.
Wilbur & Williams Co., 139 Lincoln St., Brighton 35, Boston, Mass.
Wildw Mfg. Co., Inc., Mechanic St. and Erie R. R., Port Jervis, N. Y.
Williams, E. T., 32 W 40th St, New York, N. Y.
Wilson Inc., Thomas C., 21-11 44th Avenue, Long Island City 1, N. Y.
Wingate Mfg. Co., Dixie Road, RFD 4, Charlotte, N C.
Wolf Condenser Works, 769 Hart St., Brooklyn 21, N. Y.
Worthington Corporation, 421 Worthington Av., Harrison, N. J.
Wright Chemical Corporation, 627 W. Lake St., Chicago 6, Ill.
Wyandotte Chemicals Corp., P. O. Drawer 111, Wyandotte, Mich.
Wyatt, O. M., 122 Acton Road, Columbus 2, Ohio.

Y

Yates-American Machine Company, 729 Fourth St., Beloit, Wis.
York Corporation, York, Pa.
Ala.: Birmingham, 1221 Concord Ave.
Calif.: Los Angeles 58, 5051 Santa Fe Ave.
San Francisco 3, 1275 Folsom St.
Colo.: Denver 4, 1154 Bannock St.
D. C.: Washington 6, 1014 duPont Circle Bldg.
Fla.: Ft. Lauderdale, 1540 Southwest 47th Terrace
Orlando, 318 E. Princeton Ave.
Ga.: Atlanta 12, 412 Houston St., N.E.
Savannah, R. F. D. 3, Cedar Hammock
Ill.: Chicago 31, 5050 Touhy Ave.
Ind.: Indianapolis 4, 899 Massachusetts Ave.
Ky.: Louisville 7, 4318 Priarwood Rd.
La.: New Orleans 12, 501 Delta Bldg.
Md.: Baltimore, 700 N. Pulaski St.
Mass.: Boston 16, 31 St. James Ave.
Mich.: Detroit 2, 5934 Second Blvd.
Minn.: St. Paul W4, 1952 University Ave.
Mo.: Kansas City 11, 34th and Broadway
St. Louis 2, 117 S. 11th St.
Nebr.: Omaha 8, 1213 Jackson St.
N. Y.: New York 17, 100 E. 42nd St.
Rochester 5, 471 St. Paul St.
N. C.: Charlotte, 501 E Morehead St.
Ohio: Cincinnati 2, Daylight Bldg., 659 E. 6th St.
Cleveland 13, 2700 Washington Av., N.W.
Columbus 11, 2910 Gerbert Rd.
North Canton, 630 W. Maple St.
Okla.: Tulsa, 327 Mayo Bldg.
Pa.: Erie, 3924 Lewis Ave., Apt. 4.
Philadelphia 2, Three Penn Center Plaza.
Pittsburgh 22, 7 Stanwix St.
Tenn.: Knoxville, 5925 Holston Hills Rd.
Memphis 3, 727 Dermon Bldg., 46 N. 3rd.
Texas: Dallas 1, 1707 Cedar Springs Rd.
Fort Worth 4, 2548 Wabash St.
Houston 1, 2201 Texas Ave.
San Antonio 5, 1541 West Summit.
Va.: Richmond 20, 311 W. Grace St.
Wash.: Seattle 9, 1202 Harrison St.
W. Va.: St. Albans, 1923 Parkview Dr.
Young Radiator Company, 700 Marquette St., Racine, Wis.

Z

Zonolite Company, 135 S. LaSalle St., Chicago 3, Ill.

Trade Names of Products

REFER TO PAGE 42 FOR COMPLETE ADDRESSES

A

ABSO-DRY—Henry Valve Co., Melrose Park, Ill.
ABSORBITE—Bernsby-Cheney Co., Columbus, Ohio
ACI—American Coils Co., Newark, N. J.
ACMA—Cash Valve Mfg. Corp., A. W., Decatur, Ill.
ACRAWATT—Acra Electric Corp., Franklin Park, Ill.
ADCOTE—Swift & Co., Chicago, Ill.
AEROFUSE—Tuttle & Bailey Inc., New Britain, Conn.
AEROPASS—Niagara Blower Co., New York, N. Y.
AEROVANE—Tuttle & Bailey Inc., New Britain, Conn.
AIRCLEAR—General Ozone Corp., Chicago, Ill.
AIRCO—Air Reduction Sales Co., New York, N. Y.
AIRDITIONER—Modine Mfg. Co., Racine, Wis.
AIR-LEC DOOR OPERATORS—Schoellkopf Mfg. Co., Madison, Wis.
AIR-SCOOP—Taco Heaters Inc., Cranston, R. I.
AIRTEMP—Airtemp Div., Chrysler Corp., Dayton, Ohio
ALL-TEMP—Carey Mfg. Co., Philip, Cincinnati, Ohio
ALPHETRON—NRC Equipment Corp., Newton, Mass.
ALUMISATIN—Alumiseal Corp., New York, N. Y.
ALUMISEAL—Alumiseal Corp., New York, N. Y.
AMCO—Crinnell Co., Providence, R. I.
AMER-GLAS—American Air Filter Co., Louisville, Ky.
AMERICAN MARSH—American Marsh Pumps Inc., Battle Creek, Mich.
AMPCOLD—American Plate Freezer Corp., E. Boston, Mass.
ANCO—Anderson Chemical Co., Macon, Ga.
ANDRITE—Ansul Chemical Co., Marinette, Wis.
ANEMOSTAT AIR DIFFUSER—Anemostat Corp. of America, New York, N. Y.
ANEMOTHERM AIR METER—Anemostat Corp. of America, New York, N. Y.
ANGLE COMPRESSORS—Clark Bros. Co., Olean, N. Y.
ANKORITE—Anchor Packing Co., Philadelphia, Pa.
ANSUL—Ansul Chemical Co., Marinette, Wis.
APEX—Uehling Instrument Co., Paterson, N. J.
A-P CONTROLS—Controls Company of America, Milwaukee, Wis.
APRILAIRE—Research Products Corp., Madison, Wis.
AQUA—Aqua Electric Scale Control Inc., Cleveland, Ohio
AQUACOOLER—Morley Co., Kansas City, Mo.
AQUAMATIC—Recold Corporation, Los Angeles, Calif.
AQUATOWER—Morley Co., Kansas City, Mo.
ARMOUR—Armour and Company, Chicago, Ill.
ARMSTRONG—Armstrong Cork Co., Lancaster, Pa.
ARMSTRONG—Armstrong Machine Works, Three Rivers, Mich.
ARROW-HART—Arrow-Hart & Hegeman Electric Co., Hartford, Conn.
ARTIC—duPont deNemours & Co., E. I., Wilmington, Del.
ASCO—Automatic Switch Co., Orange, N. J.
ASICO—Accuracy Scientific Instrument Co., Philadelphia, Pa.
ATCOMETER—Automatic Temperature Control Co., Philadelphia, Pa.
ATCORNIC—Automatic Temperature Control Co., Philadelphia, Pa.
ATCOTRAN—Automatic Temperature Control Co., Philadelphia, Pa.
ATCOTROL—Automatic Temperature Control Co., Philadelphia, Pa.
ATKOMATIC—Atkomatic Valve Co., Indianapolis, Ind.
ATLAS—Atlas Valve Co., Newark, N. J.
ATMO-SPRA—Watkins Co., J. E., Maywood, Ill.
ATOMICK—Maid-O-Mist Inc., Chicago, Ill.
AURORA APCO—New York Air Brake Co., Aurora Pump Div., Aurora, Ill.
AUTO-LITE—Electric Auto-Lite Co., Instrument & Gauge Div., Toledo, Ohio
AUTO-VENT—Maid-O-Mist Inc., Chicago, Ill.

B

BAC—Baltimore Aircoil Co., Baltimore, Md.
BAC—Brunner Mfg. Co., Utica, N. Y.
BAHNSON—Bahnson Co., Winston-Salem, N. C.

BAND-IT—Band-It Co., Denver, Colo.
B&W—Babcock & Wilcox Co., Beaver Falls, Pa.
BANTAM—Gelber & Sons Inc., Samuel S., Chicago, Ill.
BARRELED SUNLIGHT—Barreled Sunlight Paint Co., Providence, R. I.
BARRYMOUNT—Barry Controls Inc., Watertown, Mass.
BEMCO—Bemco Inc., North Hollywood, Calif.
BERNA PINK ACID—Berna Corp., Garwood, N. J.
BIRKENWALD—Birkenwald Mfg. Co., Portland, Ore.
BLO-CRETE—Zonolite Co., Chicago, Ill.
BLUE BANTAM—Henry Valve Co., Melrose Park, Ill.
BOND TITE—Baldwin-Hill Co., Trenton, N. J.
BOSSMAN—Thompson Refrigeration Corp., Chicago, Ill.
BOWER BRAND—Bower Chemical Co., Henry, Philadelphia, Pa.
B-P TEMPLETS—Parada & Page, Inc., Kansas City, Mo.
BRISTOL'S—Bristol Co., Waterbury, Conn.
BRUNNER—Brunner Mfg. Co., Utica, N. Y.
BRUNNER-METIC—Brunner Mfg. Co., Utica, N. Y.
BRYANT—Carrier Corp., Syracuse, N. Y.
BUSS—Bussmann Mfg. Co., St. Louis, Mo.
BUTCHER BOY—Butcher Boy Refrigerator Door Co., Harvard, Ill.

C

CALI-FLO—Watkins Co., J. E., Maywood, Ill.
CAMEO—Linde Co., Div. of Union Carbide Corp., New York, N. Y.
CANDOR—Candor Engineering Co., Montclair, N. J.
CAN-O-GAS—Virginia Smelting Co., West Norfolk, Va.
CARBOLINEUM—Carbolineum Wood Preserving Co., Milwaukee, Wis.
CAR-CEL—Dole Refrigerating Co., Chicago, Ill.
CARDINAL—American Hair & Felt Co., Chicago, Ill.
CASH—Cash Valve Mfg. Corp., A. W., Decatur, Ill.
CATCH-ALL—Spartan Valve Co., St. Louis 17, Mo.
CATERPILLAR—Caterpillar Tractor Co., Peoria, Ill.
CAUSUL—Lunkenheimer Co., Cincinnati, Ohio
CEL-LINE—Dole Refrigerating Co., Chicago, Ill.
CENTRAVAC—Trane Co., LaCrosse, Wis.
CENTRIMAX—Leeds & Northrup Co., Philadelphia, Pa.
CERTIFIED CLIMATE—Parks Cramer Co., Fitchburg, Mass.
CHASE—Chase Brass & Copper Co., Waterbury, Conn.
CHEMSOL—Chemsol, Inc., Elizabeth, N. J.
CHENCO—Chemical Engineering Co., Dallas, Texas
CHICAGO—Chicago Blower Corp., Franklin Park, Ill.
CHILLJET—Industrial Mfg. & Engineering Co., Chicago, Ill.
CINCINNATI SUB-EZRO—Cincinnati Sub-Zero Products, Cincinnati, Ohio
CLARK—Clark Bros. Co., Olean, N. Y.
CLE-MATIC MOTORS—Cleveland Electric Motor Co., Cleveland, Ohio
CLERTEMPICE—Born Refrigeration Co., Chicago, Ill.
COLD-CEL—Dole Refrigerating Co., Chicago, Ill.
COLDMOBILE—Coldmobile Div., Union Asbestos & Rubber Co., Blue Island, Ill.
COLUMBIA—Columbia Electric Mfg. Co., Cleveland, Ohio
CONNECTOR—Maid-O-Mist Inc., Chicago, Ill.
CONVERT-TO-COOL—Typhoon Air Conditioning Co., Brooklyn, N. Y.
COOLMASTER—Kramer Trenton Co., Trenton, N. J.
COR-IN—Rotometals, San Francisco, Calif.
COSMOLUB-RIC—Houghton & Co., E. F., Philadelphia, Pa.
CROLOY—Babcock & Wilcox Co., Beaver Falls, Pa.
CROSS-VIC—Henry Valve Co., Melrose Park, Ill.
CSCO—Chemical Solvent Co., Birmingham, Ala.
CURVETTE—Kramer Trenton Co., Trenton, N. J.
CYCLOMATIC—Cyclomatic Freezing Systems Inc., Chicago, Ill.
CYL-SEAL—West Chester Chemical Co., West Chester, Pa.

D

DACOR—Barnebey-Cheney Co., Columbus, Ohio
DAMPCOAT—Wilbur & Williams Co., Boston, Mass.
D&C—Coldmobile Div., Union Asbestos & Rubber Co., Blue Island, Ill.
DAY & NIGHT—Carrier Corp., Syracuse, N. Y.
DEADY ADJUSTABLE—Deady Chemical Co., Kansas City, Kans.
DEAN—Dean Products Inc., Brooklyn, N. Y.
DEAN COLD PLATES—Dean Products Inc., Brooklyn, N. Y.
DE-FROST-IT—Paragon Electric Co., Two Rivers, Wis.
DEMING—Deming Co., Salem, Ohio
DEODORITE—Barnaby-Cheney Co., Columbus, Ohio
DETROIT—Detroit Controls Corp., Detroit, Mich.
DIMCO—Detroit Ice Machine Co., Detroit, Mich.
DISTILEX—Chemical Solvent Co., Birmingham, Ala.
DORFX—Conner Engineering Corp., Danbury, Conn.
DOUBLE SEAL—Double Seal Ring Co., Fort Worth, Tex.
DOVER—Dover Mfg. Co., Independence, Mo.
DOWEX—Dow Chemical Co., Midland, Mich.
DOWFLAKE—Dow Chemical Co., Midland, Mich.
DRICON—Recold Corperation, Los Angeles, Calif.
DRI-FAN—Recold Corperation, Los Angeles, Calif.
DRIFREEZE—Berna Corp., Garwood, N. J.
DRY—Air-Perma-Ster Mfg. Co., Paterson, N. J.
DRY-EX—Acme Industries, Jackson, Mich.
DRYMASTER—Dryomatic Corp., Alexandria, Va.
DRYOMATIC—Dryomatic Corp., Alexandria, Va.
DUPL-BILT—Herbers & Co. Inc., Wm. J., Telford, Pa.
DUCO—DuPont deNemours & Co., E. I., Wilmington, Del.
DUCTURN—Tuttle & Bailey, Inc., New Britain, Conn.
DULUX—DuPont deNemours & Co., E. I., Wilmington, Del.
DUO-PASS—Niagara Blower Co., New York, N. Y.
DUZALL—Fine Products Co., Berwyn, Ill.
DYFOAM—Dyfoam Corp., New Castle, Pa.
DYNA-PUMP—Gelber & Sons Inc., Samuel S., Chicago, Ill.

E

EC&M—Electric Controller & Mfg. Co., Cleveland, O.
ECLIPSE—Frick Co., Waynesboro, Pa.
ELECTRO-CELL—American Air Filter Co., Louisville, Ky.
ELECTRO-KLEAN—American Air Filter, Louisville, Ky.
ELECTRO-MATIC—American Air Filter, Louisville, Ky.
ELECTROMAX—Leeds and Northrup Co., Philadelphia, Pa.
ELECTRO-PL—American Air Filter Co., Louisville, Ky.
ENAMELITE—Presstite-Keystone Engineering Products, St. Louis, Mo.
ERIE—Erie Tool Works, Erie, Pa.
ESKIMO—Ballard Sales Co., Fort Worth, Tex.
EVAPOTROL—Alco Valve Co., St. Louis, Mo.
EXIDE—Exide Industrial Div., Electric Storage Battery Co., Philadelphia, Pa.
EXTREMULTUS—Etremultus Inc., New York, N. Y.
EZ-KLEEN—Research Products Corp., Madison, Wisc.

F

FACT-O-CRETE—O'Neill Floors Co., E. H., Cicero, Ill.
FAIRBANKS-MORSE—Fairbanks Morse & Co., Chicago, Ill.
F&E—Flynn and Emrich Co., Baltimore, Md.
FFRRENEWO—Lunkenheimer Co., Cincinnati, Ohio
FERRUBRON—Ferrubron Metal Paint Co., Milwaukee, Wisc.
FERRUBRON—Carbolineum Wood Preserving Co., Milwaukee, Wisc.
FIBERGLAS—Owens-Corning Fiberglas Corp., Toledo, Ohio
FIN-FAN—Fluor Products Co., Whittier, Calif.
FIRE-BAN—O'Neill Floors Co., E. H., Cicero, Ill.
FLAKICE—Flakice Corp., Brooklyn, N. Y.
FLEXAZONE—Drayer-Hanson, Los Angeles, Calif.
FLEXFLYTE—Flexible Tubing Corp., Guilford, Conn.
FLEXON—Flexonics Corp., Maywood, Ill.
FLEX-VENT—Flexible Tubing Corp., Guilford, Conn.
FLO—Allin Mfg. Co., Chicago, Ill.
FLORITE—Bacharach Industrial Instrument Co., Pittsburgh, Pa.
FLOW-COLD—Acme Industries, Inc., Jackson, Mich.
FLOW-MASTER—Sporlan Valve Co., St. Louis, Mo.
FLOW-MIZER—Acme Industries, Inc., Jackson, Mich.
FLOW-PAC—Acme Industries, Inc., Jackson, Mich.
FLOW-THERM—Acme Industries, Inc., Jackson, Mich.
FLUIDYNE—Peerless Pump Div., Food Machinery & Chemical Corp., Los Angeles, Calif.
FLUOR FORMED—Fluor Products Co., Whittier, Calif.
FOAMGAS—Pittsburgh Corning Corp., Pittsburgh, Pa.
FOLCOLD—Drayer-Hanson, Los Angeles, Calif.
FOXBORO—Foxboro Co., Foxboro, Mass.
FREE-VANE—Bristol Co., Waterbury, Conn.
FREEZE-CEL—Dole Refrigerating Co., Chicago, Ill.
FREON—DuPont deNemours & Co., E. I., Wilmington, Del.
FREZALL DRY ICE—Spencer Chemical Co., Kansas City, Mo.
FRICK—Frick Co., Waynesboro, Pa.
FRIGIDCOAT—Wilbur & Williams Co., Brighton, Boston, Mass.
FROSTLINE—American Machine & Metals Inc., Sellersville, Pa.
FROSTOP—Jamison Cold Storage Door Co., Hagerstown, Md.
FULFLO—Commercial Filters Corp., Melrose, Mass.
FULL-GRIP—Maurey Mfg. Corp., Chicago, Ill.
FULL-VISION—Acme Protection Equipment Co., South Haven, Mich.
FUSETRON—Bussmann Mfg. Co., St. Louis, Mo.
FUSTAT—Bussmann Mfg. Co., St. Louis, Mo.

G

GALVICON—Galvicon Corp., Chemical Div., New York, N. Y.
GAYVAC—Gay Engineering Corp., Los Angeles, Calif.
G.E.—General Electric Co., Schenectady, N. Y.
GEMCO—Moore, Inc., Goodloe F., Danville, Ill.
GENERAL ELECTRIC—General Electric Co., Schenectady, N. Y.
GENETRON—General Chemical Div., Allied Chemical & Dye Corp., New York, N. Y.
GLASFLEECE—Carney Co. Inc., Mankato, Minn.
GLAZKOTE—O'Neill Floors Co., E. H., Cicero, Ill.
GLUCOSATES—Haering & Co., Inc., D. H., San Antonio, Tex.
GOLDEN BANTAM—Henry Valve Co., Melrose Park, Ill.
GOODFELLOW—Goodfellow Co., Inc., E. D., Memphis, Tenn.
GOOD PUMPS—Goodfellow Co. Inc., E. D., Memphis, Tenn.
GOTHAM—American Machine & Metals Inc., Sellersburg, Pa.
GOULDS—Goulds Pumps Inc., Seneca Falls, N. Y.
GUSHER—Ruthman Machinery Co., Cincinnati, Ohio
GYROL—American Blower Corp., Detroit, Mich.

H

HACCO—Hawkins Chemical Co., Los Angeles, Calif.
HALL-IDEAL—Hall Machine Shop, New Smyrna Beach, Fla.
HANDICAN—Pennsalt Chemicals Co., Philadelphia, Pa.
HAVENS—Havens Structural Steel Co., Kansas City, Mo.
HEAT-CEL—Dole Refrigerating Co., Chicago, Ill.
HENRY—Henry Valve Co., Melrose Park, Ill.
HI-CAP—Bussmann Mfg. Co., St. Louis, Mo.
HI-G-CONTROLS—General Controls Co., Glendale, Calif.
HI-LIFT—Peerless Pump Div., Food Machinery & Chemical Corp., Los Angeles, Calif.
HIGH-TEMP—Carey Mfg. Co., Philip, Cincinnati, Ohio
H-O-H—Haering & Co. Inc., D. W., San Antonio, Tex.
HONAN-CRONE—Commercial Filters Corp., Melrose, Mass.
HOUGHTON-CLEAN—Houghton & Co., E. F., Philadelphia, Pa.
HOWE—Howe Ice Machine Co., Chicago, Ill.
HUBBELL—Hubbell Corp., Mundelein, Ill.
HYDROMOTOR VALVES—General Controls Co., Glendale, Calif.
HYDRO-FLO—Bell & Gossett Co., Morton Grove, Ill.
HYDROIL—Anchor Packing Co., Philadelphia, Pa.
HYDRO-LINE—Peerless Pump Div., Food Machinery & Chemical Corp., Los Angeles, Calif.
HYDRYER—Pritchard & Co. of California, J. F. Kansas City, Mo.
HYGRODIAL—Friez Instrument Div., Bendix Aviation Corp., Baltimore, Md.

I

ICE-A-TERIA—Perfection Ice Scoring Machine Co., Fort Worth, Tex.
ICE BOY—Yates American Ice Machine Co., Beloit, Wisc.
ICE-CEL—Dole Refrigerating Co., Chicago, Ill.
ICIZER—Lilly Co., Memphis, Tenn.
IMECO—Industrial Mfg. & Engineering Co., Chicago, Ill.
IMPERVO—Carey Mfg. Co., Philip, Cincinnati, Ohio
IN-HIB-CO.—Haering & Co. Inc., D. W., San Antonio, Tex.
INSTANT—Liquid Freeze Corp., Oakland, Calif.
INSULAG—Quigley Co. Inc., New York, N. Y.
IPECO—Ice Plant Equipment Co., Inc., Philadelphia, Pa.
ISOTRON—Pennsylvania Salt Mfg. Co., Philadelphia, Pa.

J

JAMISON—Jamison Cold Storage Door Co., Hagerstown, Md.
JARENE—Jarrow Products Inc., Chicago, Ill.
JARROW—Jarrow Products Inc., Chicago, Ill.
JBT—JBT Instruments Inc., New Haven, Conn.
JOINTITE—Mundet Cork Corp., North Bergen, N. J.
JUSTRITE—Justrite Manufacturing Co., Chicago, Ill.

K

KATHABAR—Surface Combustion Corp., Toledo, Ohio
KAY-TEE—Kramer Trenton Co., Trenton, N. Y.
KEN-KAY—Refrigeration Engineering Co., Minneapolis, Minn.
KING-CLIP—Lunkenheimer Co., Cincinnati, Ohio
KING SHARP—King Co., Owatonna, Minn.
KING-ZEERO—King Zeero Co., Chicago, Ill.
KLIMATIC KING—King Co., Owatonna, Minn.
KLUMENE-131—American Potash & Chemicals Corp., Los Angeles, Calif.
KNO-DRAFT—Connor Engineering Corp., Danbury, Conn.
KOLDBOARD—Baldwin-Hill Co., Trenton, N. J.
KOLDWALL—King Co., Owatonna, Minn.
KRACK—Refrigeration Appliances Inc., Chicago, Ill.
KRUPP—Shank Co., Cyrus, Chicago, Ill.

L

LA-CO—Lake Chemical Co., Chicago, Ill.
LAYKOLD—American Bitumuls & Asphalt Co., San Francisco, Calif.
LAYNE—Layne & Bowler, Memphis, Tenn.
LED-PLATE—Armite Laboratories, Los Angeles, Calif.
LEVEL-EYE—Phillips & Co., H. A., Chicago, Ill.
LEVEL-MASTER—Sporlan Valve Co., St. Louis, Mo.
LEWIS—Lewis & Co. Inc., Chas. S., St. Louis, Mo.
LEWIS-SHEPARD—Lewis-Shepard Products, Inc., Watertown, Mass.
LINDE—Linde Co., Div. of Union Carbide Corp., New York, N. Y.
LIPMAN—Yates American Machine Co., Beloit, Wisc.
LIQUID EYE—Allin Mfg. Co., Chicago, Ill.
LITTLE GIANT—Gelber & Sons Inc., Samuel S., Chicago, Ill.
LO-BOY—Fine Products Co., Berwyn, Ill.
LO-LINE—Pritchard & Co. of California, J. F., Kansas City, Mo.
LO-TEMP—Industrial Mfg. & Engineering Co., Chicago, Ill.
LO-TEMP—Jamison Cold Storage Door Co., Hagerstown, Md.
L-S—Lewis-Shepard Products Inc., Watertown, Mass.
LUNGS FOR INDUSTRY—General Blower Co., Morton Grove, Ill.

M

MAINTZ—West Chester Chemical Co., West Chester, Pa.
MARKAL PAINTSKIKS—Markal Co., Chicago, Ill.
MARLO—Marlo Coil Co., St. Louis, Mo.
MASONEILAN—Mason-Neilan Regulator Co., Norwood, Mass.
MASTERGAUGE—Marsh Corp., James P., Skokie, Ill.
MASTER-LINE—Lewis-Shepard Products Inc., Watertown, Mass.
MAUREY—Maurey Mfg. Corp., Chicago, Ill.
MAUREYMATIC—Maurey Mfg. Corp., Chicago, Ill.
MAXICORDERS—Dickson Co., Chicago, Ill.
MEMPHO ALGICIDE—Deady Chemical Co., Kansas City, Kansas
MEMPO—Deady Chemical Co., Kansas City, Kansas
MERCOID—Marcoid Corp., Chicago, Ill.
MERCONTROL—Mercoid Corp., Chicago, Ill.
Meriam—Meriam Instrument Co., Cleveland, Ohio
MICHIANA—Commercial Filters Corp., Melrose, Mass.
MICRON—Micron Inc., Bettendorf, Iowa
MICROVAC—Stokes Machine Co., F. J., Philadelphia, Pa.

MILLER—Miller & Sons Inc., Franklin P., East Orange, N. J.
MINICORDER—Dickson Co., Chicago, Ill.
MINI-LINE—Bailey Meter Co., Cleveland, Ohio
MOGUL—North American Mogul Products Co., Cleveland, Ohio
MONO-BLOCK—Baldwin-Hill Co., Trenton, N. J.
MONOGRAM LINE—Refrigerating Specialties Co., Chicago, Ill.
MONOMOVER—Baldwin-Hill Co., Trenton, N. J.
MOR-AIRE—Mourey Mfg. Corp., Chicago, Ill.
MOR-GRIP—Mourey Mfg. Corp., Chicago, Ill.
MORLET—Union Carbide & Chemicals Co. Div. Union Carbide Corp., New York, N. Y.
MORTITE—Mortell Co., J. W., Kankakee, Ill.
MULTI-DUTY—American Air Filter Co., Louisville, Ky.
MYSTIK—Mystik Adhesive Products, Chicago, Ill.

N

NARCOIL—NRC Equipment Corp., Newton, Mass.
NARESCOIL—NRC Equipment Corp., Newton, Mass.
NASH—Nash Engineering Co., South Norwalk, Conn.
NATIONAL—Barada & Page Inc., Kansas City, Mo.
NEOCOAT—Pennsylvania Salt Mfg. Co., Philadelphia, Pa.
NMD—Lunkenheimer Co., Cincinnati, Ohio
NO DRIP—Mortell Co., J. W., Kankakee, Ill.
NOR-LAKE—Nor-Lake Inc., Hudson, Wisc.
NOVOID—National Cork Co., Englewood, N. J.
NRC—NRC Equipment Corp., Newton, Mass.

O

OAKITE—Oakite Products Inc., New York, N. Y.
OHIO SPECIAL—Ohio Galvanizing and Mfg. Co., Niles, Ohio
OIL-EX—Ton-Tex Corp., Grand Rapids, Mich.
OILOUT—Niagara Blower Co., New York, N. Y.
OL' FAITHFUL—Maid-O-Mist Inc., Chicago, Ill.
OMAZOTE—Tiderrider Inc., Baldwin, N. Y.
OSPHO—Rusticide Products Co., Cleveland, Ohio
OX-PHOS—DEADY Chemical Co., Kansas City, Kansas
OZITE—American Hair & Felt Co., Chicago, Ill.

P

PAKICE—Vilter Manufacturing Co., Milwaukee, Wisc.
PALCOMATE—Pacific Lumber Co., San Francisco, Calif.
PALCOTRAN—Pacific Lumber Co., San Francisco, Calif.
PALCO WOOL—Pacific Lumber Co., San Francisco, Calif.
PANDUX—Pacific Transducer Corp., Los Angeles, Calif.
PARAGON—Paragon Electric Co., Two Rivers, Wisc.
PAR-CORK—Parham Industries Inc., Detroit, Mich.
PAR-FOAM—Parham Industries Inc., Detroit, Mich.
PAYNE—Carrier Corp., Syracuse, N. Y.
PENNPAINT—Pennsylvania Salt Mfg. Co., Philadelphia, Pa.
PENNSALT—Pennsalt Chemicals Corp., Philadelphia, Pa.
PERFECTO—Carey Mfg. Co., Philip, Cincinnati, Ohio
PERMA-FAN—Drayer-Hanson, Los Angeles, Calif.
PERMAMIX—Permamix Corp., Chicago, Ill.
PHILLIPS—Phillips & Co., H. A., Chicago, Il.
PIPEMASTER—Erie Tool Works, Erie, Pa.
POLAR—Refrigeration Engineering Co., Minneapolis, Minn.
POLARFLAKE—Vilter Mfg. Co., Milwaukee, Wisc.
POLYFOAM—Glo-Brite Products Inc., Chicago, Ill.
POLY-GRID—Fluor Products Co., Whittier, Calif.
POMONA—Fairbanks-Morse & Co., Chicago, Ill.
PRESSTITE—Presstite-Keystone Engineering Products, St. Louis, Mo.
PRESSURIZER—Watkins Co., J. E., Maywood, Ill.
PRESSURMITE—Friez Instrument Div., Bendix Aviation Corp., Baltimore, Md.
PREST-O-MATIC—Clark Door Co. Inc., Newark, N. J.
PROCON—Procon Pump & Engineering Co., Oak Park, Mich.
PROP-R-TEMP—Typhoon Air Conditioning Co., Brooklyn, N.
PSYCHRON—Friez Instrument Div., Bendix Aviation Corp., Baltimore, Md.
PUR-AIR—Barneby-Cheney Co., Columbus, Ohio
PUR-A-WELD—Acme Protection Equipment Co., South Haven, Mich.
PUR-O-TEX—Ton Tex Corp., Grand Rapids, Mich.
PYRATHERM—Mercoid Corp., Chicago, Ill.
PYROCOUPLE—Royco Instruments, Albany, Calif.
PYROTRON—Bailey Meter Co., Cleveland, Ohio

Q

QUICK-DUMP—Humphrey Products Div., General Gas Light Co., Kalamazoo, Mich.
QUICKSEAL—Born Refrigerating Co., Chicago, Ill.

R

RADI-AIRE—Raynolds Electric Co., River Grove, Ill.
RAMARET—Parmutit Co., New York, N. Y.
RANCO—Ranco Inc., Columbus, Ohio
R&M—Robbins & Myers Inc., Springfield, Ohio
READY-POWER—Ready Power Co., Detroit, Mich.
RECIRCULATOR—Watkins Co., J. E., Maywood, Ill.
RECO—Reynolds Electric Co., River Grove, Ill.
RECOLD—Recold Corporation, Los Angeles, Calif.
RECOY—Recoy Products Co., Canton, Ohio
REGALY—Rotometals, San Francisco, Calif.
REGUTRON—Electric Machinery Mfg. Co., Minneapolis, Minn.
RELIANCE—Reliance Electric & Engineering Co., Cleveland, Ohio
RENEWO—Lunkenheimer Co., Cincinnati, Ohio
REX—Rex Engineering & Sales Co., Oklahoma City, Okla.
RING-JET—Stokes Machines Co., F. J., Philadelphia, Pa.
R-K—Ruggles-Klingemann Mfg. Co., Salem, Mass.
ROCK-SEAL—West Chester Chemical Co., West Chester, Pa.
ROLL-O-MATIC—American Air FILTER Co., Louisville, Ky.
ROOTS—Roots-Connersville Blower Div., Dresser Industries, Connersville, Ind.
ROTARIUM BABBITTS—Rotometals, San Francisco, Calif.
ROTASPRAT—Carrier Corp., Syracuse, N. Y
ROTO—Elliott Co., Roto Div., Newark, N. J.
ROTODIESEL—Rotometals, San Francisco, Calif.
ROTOJET—Elliott Co., Roto Div., Newark, N. J.
ROTOMET—Rotometals, San Francisco, Calif.
ROTO-METRIC—Rotometals, San Francisco, Calif.
ROTONICKEL—Rotometals, San Francisco, Calif.
R/S CONTROLS—Refrigerating Specialties Co., Chicago, Ill.
RUBALY—Hague & Co., Alfred, Brooklyn, N. Y.
RUBATEX—Great American Industries Inc., Bedford, Va.
RUBBAIR-DOOR—Stic-Klip Mfg. Co., Cambridge, Mass.
RUBBER-COAT—Wilbur & Williams Co., Boston, Mass.
RUBBERFLEX—Bushings Inc., Royal Oak, Mich.
RUMACO—Ruthman Machinery Co., Cincinnati, Ohio
RUSTICIDE—Rusticide Products Co., Cleveland, Ohio
RUST VETO—Houghton & Co., E. F., Philadelphia, Pa.

S

SAFETY SEAL—Safety Seal Piston Ring Co., Fort Worth, Tex.
SANTROL—Tuttle & Bailey Inc., New Britain, Conn.
SARINE—Berne Corp., Garwood, N. J.
SERVICEMAN—Marsh Corp., James P., Skokie, Ill.
SHANK—Shank Co., Cyrus, Chicago, Ill.
SHERWOOD—Aluminum & Brass Co., Lockport, N. Y.
SHRIN-KONTROL—Watkins Co., J. E., Maywood, Ill.
SIL-CLAD—Electric Machinery Manufacturing Co., Minneapolis, Minn.
SILENT-LIGN—Bushings Inc., Royal Oak, Mich.
SNOW PLATE—Dean Products Inc., Brooklyn, N. Y.
SOLFRUNT—American Machine & Metals Inc., Sellersville, Pa.
SOLVEX—Chemical Solvent Co., Birmingham, Ala.
SORENG—Controls Co. of America, Milwaukee, Wisc.
SPACESAVER—Fino Products Co., Berwyn, Ill.
SPASAVER—Drayer-Hanson, Los Angeles, Calif.
SPEEDOMAX—Leeds and Northrup Co., Philadelphia, Pa.
SPIRATUBE—Flexible Tubing Corp., Guilford, Conn.
SPONG—National Supply Co., Pittsburgh, Pa.
SPOTAIRE—Drayer-Hanson, Los Angeles, Calif.
SPRA-CHILLER—Watkins Co., J. E., Maywood, Ill.
SPRATOWER—Marley Co., Kansas City, Mo.
SPRUYT—Agric Machinery Corp., New York, N. Y.
STAINCURE—Wilbur & Williams Co., Brighton, Boston, Mass.
STANDARD—Standard Refrigeration Co., Chicago, Ill.
STA-PUT—Houghton & Co., E. F., Philadelphia, Pa.
STA-TITE—Superior Valve & Fittings Co., Pittsburgh, Pa.
STIC-KLIP—Stic-Klip Mfg. Co., Cambridge, Mass.
STREATOR—Streator Products Corp., Fairfield, Iowa
STURDI-LITE—Parham Industries Inc., Detroit, Mich.
STYROFOAM—Dow Chemical Co., Midland, Mich.
STYROFOAM—Glo-Brite Products Inc., Chicago, Ill.
SUNRISO—Sun Oil Co., Philadelphia, Pa.
SUPER DRY-EYE—Ansul Chemical Co., Marinette, Wisc.
SUPER FREEZER—Jamison Cold Storage Door Co., Hagerstown, Md.
SUPERGAUGE—American Machine & Metals Inc., Sellersville, Pa.
SUPERIOR—Superior Valve & Fittings Co., Pittsburgh, Pa.
SUPER POWERHOUSE—Baldwin-Hill Co., Trenton, N. J.
SUPERTHERM—American Machine & Metals Inc., Sellersville, Pa.
SUREMASTIC—Camp Co. Inc., Chicago, Ill.
SUPREME—Miller & Son Inc., Franklin P., East Orange, N. J.
SYNCHROSTAT—Electric Machinery Manufacturing Co., Minneapolis, Minn.

T

TACO—Taco Heaters Inc., Cranston, R. I.
TARGET—Anchor Packing Co., Philadelphia, Pa.
TAURIL—Anchor Packing Co., Philadelphia, Pa.
TAYLOR MADE—Taylor Made Ice Vending Mfg. Co., Eupora, Miss.
TEKTOLOG—Robertshaw Fulton Controls Co., Philadelphia, Pa.
TEKTOR—Robertshaw Fulton Controls Co., Philadelphia, Pa.
TELLTALE—Watkins Co., J. E., Maywood, Ill.
TELSTOR—Robertshaw Fulton Controls Co., Philadelphia, Pa.
TEMPATUBE—Acra Electric Corp., Franklin Park, Ill.
TEMPOINT—Bacharach Industrial Instrument Co., Pittsburgh, Pa.
TEMPRITE—Temprite Products Corp., Birmingham, Mich.
TEMPSCRIBE—Bacharach Industrial Instrument Co., Pittsburgh, Pa.
TENNY—Tenney Engineering Inc., Union, N. J.
TEXACO—Texas Co., New York, N. Y.
T-FLO—Ansul Chemical Co., Marinette, Wis.
THERMAFLEX—Flexible Tubing Corp., Guilford, Conn.
THERMATROL—Schnacke, Inc., Evansville, Ind.
THERMO—Alco Valve Co., St. Louis, Mo.
THERMOBANK—Kramer Trenton Co., Trenton, N. J.
THERMOMIX—Leeds & Northrup Co., Philadelphia, Pa.
THERMO KING—Thermo-King Co., Minneapolis, Minn.
THERMOVERTER—Bristol Co., Waterbury, Conn.
TONG TEST—Columbia Electric Mfg. Co., Cleveland, Ohio
TON-TEX—Ton-Tex Corp., Grand Rapids, Mich.
TORCH-O-MATIC—Velocity Power Tool Co., Pittsburgh, Pa.
TOT—TOT Towers Inc., Houston, Tex.
TOTRUST—Wilbur & Williams Co., Boston, Mass.
TRAXCAVATOR—Caterpiller Tractor Co., Peoria, Ill.
TRI-CALITE—Mundet Cork Corp., North Bergen, N. J.
TRIFLEX—Tuttle & Bailey Inc., New Britain, Conn.
TRIPEL A—Quigley Co. Inc., New York, N. Y.
TRONA CHARG-A-CANS—American Potash & Chemical Corp., Los Angeles, Calif.
TRUK-CEL—Dole Refrigerating Co., Chicago, Ill.
TUFCRETE—Tufcrete Co. Inc., Des Moines, Iowa
TUFDEK—Tufcrete Co. Inc., Des Moines, Iowa
TUFDENSE—Tufcrete Co. Inc., Des Moines, Iowa
TUFF-BOND—Goodloe E. Moore Inc., Danville, Ill.
TUFF-TRED—Goodloe E. Moore Inc., Danville, Ill.
TUFF-WELD—Goodloe E. Moore Inc., Danville, Ill.
TUFSEAL—Tufcrete Co. Inc., Des Moines, Iowa
TUFTITE—Tufcrete Co. Inc., Des Moines, Iowa
TUFTOP—Tufcrete Co. Inc., Des Moines, Iowa
TYPHOON—Typhoon Air Conditioning Co., Brooklyn, N. Y.

U

UCON—Union Carbide Chemicals Co., Div. of Union Carbide Corp., New York, N. Y.
UEHLING—UEHLING Instrument Co., Paterson, N. J.
UNARCO—Coldmobile Div., Union Asbestos & Rubber Co., Blue Island, Ill.
UNICHILLER—Vilter Mfg. Co., Milwaukee, Wis.
UNICON—Kramer Trenton Co., Trenton, N. J.
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V

VAPCO PRODUCTS—Garmon Co. Inc., St. Louis, Mo.
VAPOMATIC—Recold Corp., Los Angeles, Calif.
VAPO-WALL—MMM Inc., Houston, Texas
VAP-R-TYT—Jamison Cold Storage Door Co., Hagerstown, Md.
VARIDRIVE—U. S. Electrical Motors Inc., Los Angeles, Calif.
VARIDYNE—U. S. Electrical Motors Inc., Los Angeles, Calif.
VARITROL—U. S. Electrical Motors Inc., Los Angeles, Calif.
VASCO-CEL—Virginia Smelting Co., West Norfolk, Va.
VE-E-ZY—Ton Tex Corp., Grand Rapids, Mich.
VELOCITY POWER—Velocity Power Tool Co., Pittsburgh, Pa.
VENTURAFIN—American Blower Corp., Detroit, Mich.
VENTURA-SIROCCO—American Blower Corp., Detroit, Mich.
VERTIFLOW—Havens Structural Steel Co., Kansas City, Mo.
VIBRA-SORBER—Flexonics Corp., Maywood, Ill.
VIBRO-LEVELER—Bushings Inc., Royal Oak, Mich.
VIK-SYN—Houghton & Co., E. F., Philadelphia, Pa.
VILTER—Vilter Mfg. Co., Milwaukee, Wis.
VIM—Houghton & Co., E. F., Philadelphia, Pa.
VISOLEAK—Allin Mfg. Co., Chicago, Ill.
V-NOTCH WEIR—Deady Chemical Co., Kansas City, Kans.
VOGT—Vogt Machine Co., Henry, Louisville, Ky.
VORTEX—Lawrence Pump & Engine Co., Lawrence, Mass.
VOSS—Voss Co., J. H. H., New York, N. Y.

W

WAGNER—Wagner Electric Corp., St. Louis, Mo.
WALKIE—Economy Engineering Co., Chicago, Ill.
WATER-BOY—Maid-O-Mist Inc., Chicago, Ill.
WATKINS—Watkins Co., J. E., Maywood, Ill.
WAVE-FLOW—Henry Valve Co., Melrose Park, Ill.
WEATHERMASTER—Carrier Corp., Syracuse, N. Y.
WEDGETIGHT—Jamison Cold Storage Door Co., Hagerstown, Md.
WESCOLD—Stone & Co. Inc., William E., Seattle, Wash.
WESTON—Weston Electrical Instrument Co., Newark, N. J.
WILSON—Wilson Inc., Thomas C., Long Island City, N. Y.
WINGATE—Wingate Mfg. Co., Charlotte, N. C.
WINTERSTAT—Kramer Trenton Co., Trenton, N. J.
WOLF—Wolf Condenser Works, Brooklyn, N. Y.
WOLFE-LINDE—Derach, Gesswein & Neuert, Inc., Chicago, Ill.
WORKLIFTER—Economy Engineering Co., Chicago, Ill.
WORTHINGTON—Worthington Corp., Harrison, N. J.
WRAPIT—Ocra Electric Corp., Franklin Park, Ill.
WYANDOTTE—Wyandotte Chemicals Corp., Wyandotte, Mich.

Y

YEL-O-BAK—Accuracy Scientific Instrument Co., Philadelphia, Pa.
YORKAIRE—York Corp., York, Pa.

Z

Z-CRETE—Zonolite Co., Chicago, Ill.
ZER-O-DISC—Vilter Mfg. Co., Milwaukee, Wisc.
ZEROPAK—McQuay Inc., Minneapolis, Minn.
ZERO PERM—Aluminseal Corp., New York, N. Y.
ZONOLITE—Zonolite Co., Chicago, Ill.

Practical Refrigeration Engineer

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Operating engineers of all refrigerating plants are invited to affiliate with the National Association of Practical Refrigerating Engineers, Inc., an educational association, "not-for-profit".

An NAPRE Featurette ——

Getting The Most Out of Your Membership

MEMBERSHIP in almost any organization entails some costs such as dues, occasional assessments, tickets for special meetings or parties, etc. If we attend any meetings or take part in the organization or its direction, it will take up some personal time. It is perfectly proper then to ask "What do I get out of it?"

NAPRE is no different than any other organization in this respect. What do we get back for expenditures of time and cash? Perhaps the best manner in which to review NAPRE benefits is to make a list of the returns.

Different individuals will probably have different things at the top of their lists. But at or near the top of most members' lists would be the association with one of the friendliest and sincerely helpful group of fellows whoever got together; a truly fraternal-minded body of men.

Informative Meetings

Another point near the top of such a list of benefits is the information obtained at chapter meetings. The preliminary educational sessions give instruction particularly designed for the newer, younger member. The main meeting session will have information useful to both new and old members. This could all be lumped under getting more "know how" for the individual's job.

Along with the regular speaker programs at these meetings, the discussions which come about as a resullt are of great value; discussions between a speaker and members, either during a presentation, or afterwards in a question and answer period. Or the discussion may be regarding an inquiry dropped in the Question Box. Again, these all add up to more "know how" for holding or advancing in our own jobs.

Side Benefits

Beside educational meetings, there are usually two or three social meetings a year in every chapter. These give the members a chance to get better acquainted; to find out what they are interested in beside refrigeration. It is a chance to meet fellow golfer, fisherman, or bowler, for example.

If one gets out of work, the employment committee, or friends in the organization usually make it possible to get relocated. Sometimes they can tell of expected job changes, and better opportunities are opened up for members who have jobs unsatisfactory to them.

National Advantages

All the above points are local benefits. To turn to the national level, we receive the NAPRE official organ INDUSTRIAL REFRIGERATION. It keeps us posted on new plants, new designs, new trends, new equipment.

We shouldn't forget that the chapters' lecture course is made possible through an aid (the Instructor's Manual) furnished by the National Association. Your official text is a thoroughly practical book suitable for either study or reference. Yet in spite of being practical, it gives accurate, authoritative information on a wide variety of refrigeration.

Then there are the educational mailings to members. These may be a bit of very pertinent information put out by some manufacturer. Or, they may be something developed by the educational committee to give some specifically needed information.

Annual National Meetings

Probably the biggest thing at the national level is the annual convention. This is a chance to rub shoulders with, exchange ideas and seek solutions to problems from among the best operators and plant managers attending from all over the nation. It is a chance to meet your national officers and committeemen; to get on speaking terms with men whose names you hear, or read of, or occasionally see signed on a letter. It is a chance to see displays of the latest types of equipment.

For a record of the past conventions there has been the *Operating Data Book*. This has been valuable to those who attended the convention as a permanent record. But it has been particularly valuable to those who are unable to attend. It gave them the papers presented at the convention. The *Operating Data Book* has also included a Buyer's Directory, and manufacturer's information on equipment that a member will need any time a change of importance is to be made in your plant.

And what does all this cost? A few evenings a month of time, and your annual dues. This is truly a bargain in days of devaluated currency and high cost of living.

GUY R. KING

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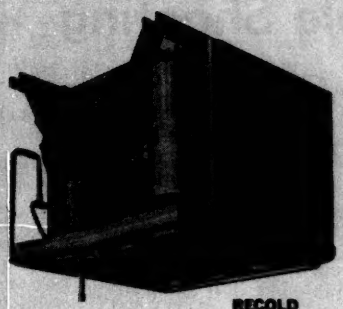

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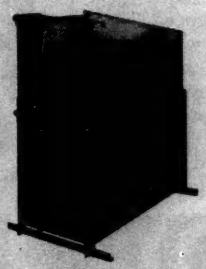

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"Perfect Circle" distribution of low-velocity, high-humidity air.

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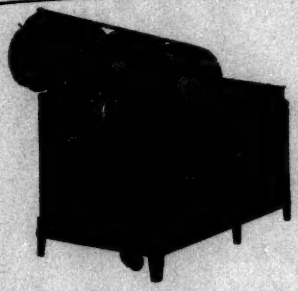

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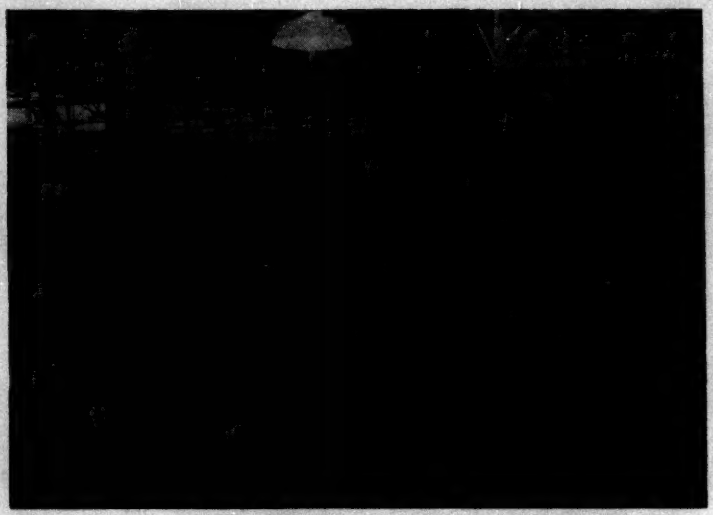
Trouble Shooting

A Motor Control Is Simple As Its Components

The Educational Committee NAPRE*

PICTURE yourself in the place of the four-to-midnight shift engineer in charge of operating utilities in a large manufacturing plant. You have just tried to start an 800-hp synchronous motor driving the main refrigerant compressor for the plant air conditioning system. The motor starts, but about the time it is up to speed, something trips out and the whole apparatus stalls.

At that point, newer, less experienced engineers often feel like they would rather have "stood in bed", would like to burrow a hole and pull the hole in after them, or long for



One operation in a Fiberglas plant of Owens-Corning Fiberglas Corp. where an industrial air conditioning system by Carrier Corp. helps maintain uniform product quality. Failure of the plant refrigerating compressor motor could be just as disturbing in an industrial plant of this nature, as in a cold storage warehouse.

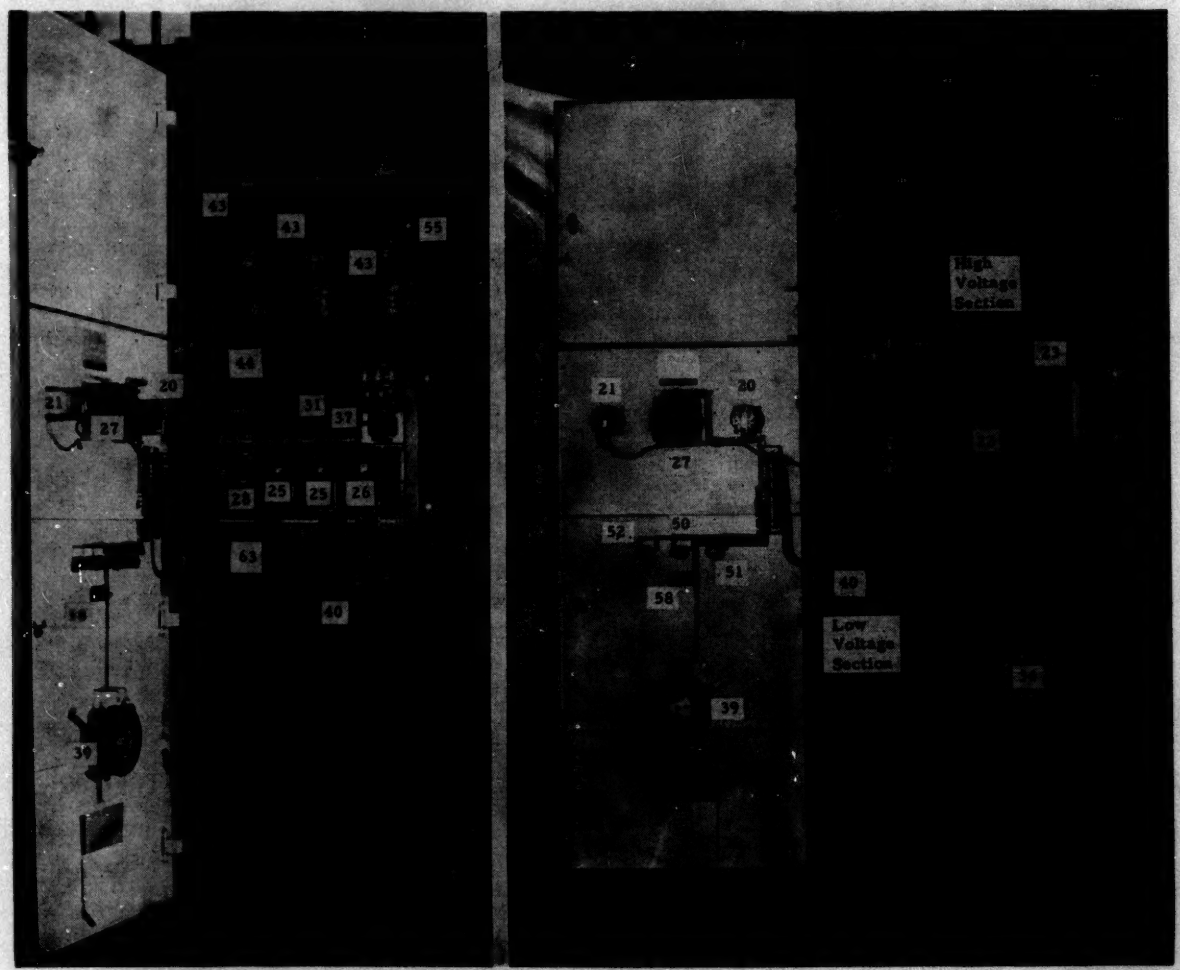


Fig. 1—Front (left) and side (right) views of the synchronous motor control portrayed schematically in Fig. 2. Positions of these numbered parts correspond to wireman's layout pictured in Fig. 3. In side view, note the arrangement which places all low voltage control circuits for front access. High voltage circuits are accessable from rear (or side, if end cabinet).

most any job than the one they are holding at the moment. Time and again, however, the trouble which caused the starting failure, was very elementary. Because the engineer had no understanding of motor starter principles, and had not been trained in elementary trouble shooting, he had to do the best thing he knew.

He put the standby equipment on, if he had it. Whether he had it or not, he probably either sent out an SOS for the plant electrician or electrical service contractor – involving overtime or double time charges against the non-elastic engineering budget, and/or in the event the plant had no electrician, the chief got a call at home and made a trip back to get things in operation again.

Fundamental Knowledge Removes Mental Strains

As noted, many times electrical failures are brought about through a minor derangement. By learning the fundamentals of the motor controls in his charge at the plant, the operating engineer takes the first step toward making his watch a less nerve-racking occupation. Having gotten the fundamentals behind him, he can study the wiring diagrams or schematics generally provided and posted inside the cover or door of the motor starting panel or cabinet (See Figs. 1, 2 & 3).

With the diagram in front of him and a better understanding of what the symbols, numbers and lines mean, plus a few thoughts of what occured up to the point of failure, the engineer can fairly well diagnose any simple ailment. Actually, he breaks the controls down into their simplest elements.

Let's go back over the actual case as mentioned, or to bring it close to reality for many NAPRE engineers, assume we have a 700-ton cold storage plant in a downtown metropolitan area. Heart of the plant is two 600-hp synchronous driven compressors. Being in a particular area where the utility network is taxed to current carrying capacity, the plant makes a daily shutdown from 4:30 to 7:30 PM in order to enjoy a better demand rate. Flywheel effect of a brine system enables the plant to get along without the ammonia refrigerating plant for these three hours.

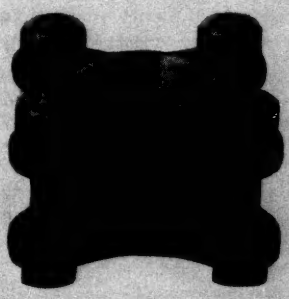
Our four-to-midnight operator has just finished his lunch (supper). Posted (standing) operating instructions call for him to restart one of the 350-ton compressors. Special (written) instructions by the Chief indicate the standby is to also go on the line tonight.

As the operator read the special instructions, he recalled some comment the Chief had made about an unknown number of carloads having been received during the day. Butter, he seemed to recall. Actually, he had noted a greater temperature differential in the brine return and supply. Usually the plant operated at about a three degree split. He had noted that the split was about 8F when he came on and would probably go a few degrees higher.

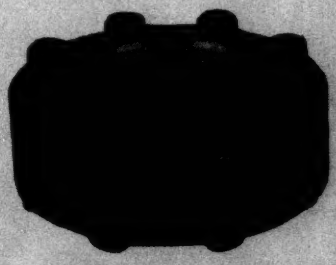
Our operator went through his usual routine of opening the discharge valve from the first stage cylinder of his horizontal, compound machine. Next he opened up the suction valve on the high pressure inlet from the inter-cooler, and the discharge from the low pressure cylinder. He opened up the small by-pass or equalizing connection and depressed the motor starting button. Like his counterpart in the manufacturing plant, it was at

*A special sub-committee tackled this assignment from NAPRE's Educational Director, LeRoy Etzel: Wm. L. Tiffin, Secretary, Chicago Chapter and Ideal Electric Co. representative at Chicago; Del W. Shobe, Assistant Sales Manager, Ideal, Mansfield, Ohio; and J. R. Kelahan, *Industrial Refrigeration* staff and NAPRE Secretary.

Oval Style — 1/4" — 1"



Square Style — 1" — 4"



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this point that he almost wished he had stayed home, for nothing happened!

However, these NAPRE engineers were not the type of fellows who become paniky easily. Our warehouse plant operator secured the valves again, went over to No. 2 machine (standby) and went through the same routine. He was a bit relieved when this unit started up without any problems whatsoever. After attending to the auxiliary items such as putting cooling water on the cylinder jackets, and watching temperatures and pressures of refrigerant, lubricating oil, water, etc. for a few minutes, he turned his attention back to the original machine. Before taking any steps, however, he reviewed the prerequisites, starting cycle and other features of that particular motor and its starting apparatus.

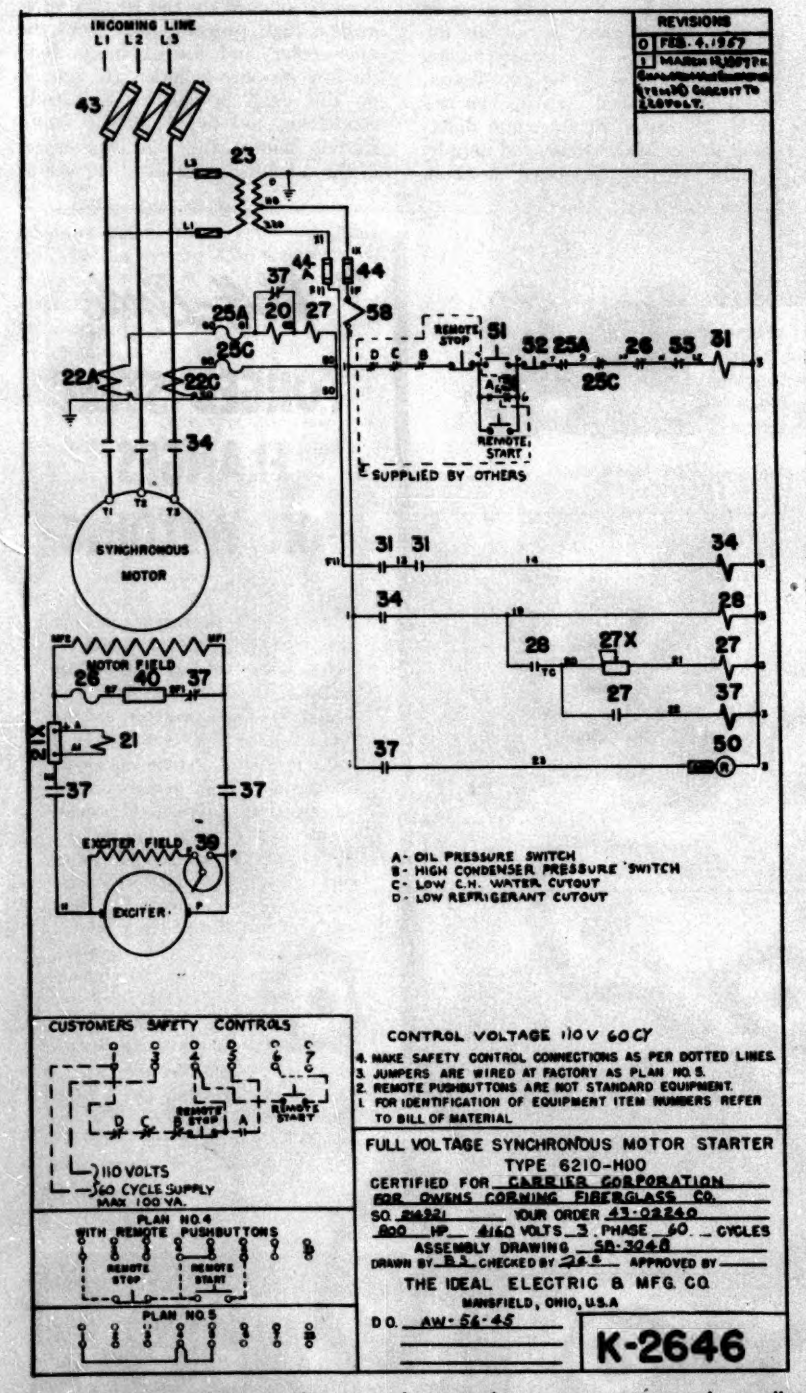

Fig. 2—Typical schematic diagram of a synchronous motor control—usually pasted to the inside of the control panel cover. Understanding of the numbered components and their functions, enables common sense trouble shooting on the part of engineers. The schematic shows sequence and functional relationship of the parts to one another.

Operation Sequence

Both our warehouse and manufacturing plant operators had been trained by their chief engineer and plant electrician on the basics[1] of their electric equipment. Here is what they had been told (for the sake of a single illustration, we'll use our 800-ton motor starter, Fig. 1):

Prerequisites: High capacity fused disconnects (#43) must be closed. Fuse compartment door must be closed, holding normally closed (NC) contacts (#55). Overlay relays (#25) and squirrel cage protective relay (#26) must be closed or reset.

Starting Cycle: Start button (#51) is depressed. This energizes control relay (#31) which in turn energizes the main line contactor (#34) and the motor starts to accelerate. Auxiliary contacts on the main contactor then energize the time relay (#28) which prevents instantaneous application of the field. At approximately 95% motor speed, the field application relay (#27) applies the excitation to the field of the motor by closing field contactor (#37). Auxiliary contacts on the field contactor energize the red indicating light (#50). The motor is now in synchronism. Adjust rheostat so DC ammeter corresponds to motor field current name plate rating.

Other Features: Field discharge resistor (#40) is in series with the motor field and the squirrel cage protective relay (#26). If field contactor (#37) does not close, or opens during operation, this relay (#26) will become overheated and collapse the control circuit which in turn stops the motor. Normally closed (NC) auxiliary contacts on the field contactor open on application of the field and remove the field discharge resistor (#40) and the squirrel cage protective relay (#26) from the circuit.

The current transformer (#22) provides for operation of the AC ammeter (#20) and the current coil in the field application relay (#27).

Fuses (#44) are for protection of the control circuit.

Exciter field rheostat (#39) controls excitation to the motor field dur-

[1]See "Basic Electric Motor Controls for Refrigeration Plants", by Howard A. Wolfberg; two parts—July 1955, page 30 and August 1955, page 27 I.R.

ing operation. The DC field ammeter (#21) is in series with the exciter and indicates field current any time the field contactor is closed.

Safety plug (#58) is merely a safety feature which will open the control circuit upon removal and prevent the motor from running.

Stopping: When the stop button (#52) is depressed, the control circuit is collapsed and the motor stops.

Trouble Shooting Involves Specific Checking Areas

Having checked the prerequisites, starting cycles and various features over in their minds, our shift operators then recalled how their chief engineers and plant electricians, plus the manufacturers' representatives had coached them on elementary inspection and trouble shooting procedures. They recalled very readily that trouble shooting involved three separate areas in the case of synchronous motors:

1) The alternating current control circuit,
2) The direct current excitation circuit, and
3) The current transformer circuit.

Now, what to do about that inoperative machine?

This cold storage plant engineer went through the same mechanical routine of readying his compressor for operation. He then tried to start the motor again. It revved up again to just about normal speed and then died off. After a few minutes interval while he again checked his pressures and temperatures with the running unit, the engineer returned and tried to start the motor again. Still no results.

Test Procedures

About this time he decided to get at the cause if he could. He opened the motor starting panel to observe the operations within. Pressing the starter button (#51)[2] he noted that the control relay (#31)[2] should close, but didn't. Ah ha, he thought, that is a good start; a sound clue to trouble of some kind.

The engineer then put his test lamp on the AC secondary (0 to 110-volt taps) of the potential transformer (#23). The test lamp glowed since there was juice at these taps, Then, he reasoned, everything up to that point is O.K., and control circuit fuse (#44) must have opened.

Finding the fuse blown was the tip-off to our engineering slueth. It indicated a short circuit in the control wiring of the starter. In this case, it was in a safety circuit. In a few minutes he had located and corrected the trouble. Replacing the fuse, but leaving the panel open so he could observe the starting sequence, he depressed #51 and this time luck was with him. His motor came up to speed and synchronized, after which he slowly opened the stop valve to his main suction line and completed the usual start-up procedure.

This was just one example of how the warehouse engineer helped himself, his own engineering department, and reduced wear and strain on the mental capacities of the plant electrician, chief engineer and management. There are many other examples—probably as numerous as there are motors and derangement possibilities. Here is what our manufacturing plant watch stander did:

Unique Safety Features

The operator pushes #51. Nothing happens! On this type of apparatus, the first thing our engineer should have done was to check #58, the safety plug. This particular feature built into the cabinet opens the motor circuit at any time the plug is removed, stopping the motor and rendering the starter inoperative.

If the safety plug is in place, the engineer should open the cabinet as

[2]Numbers given will refer to starter nomenclature of Fig. 1, as controls in both plants will be somewhat similar.

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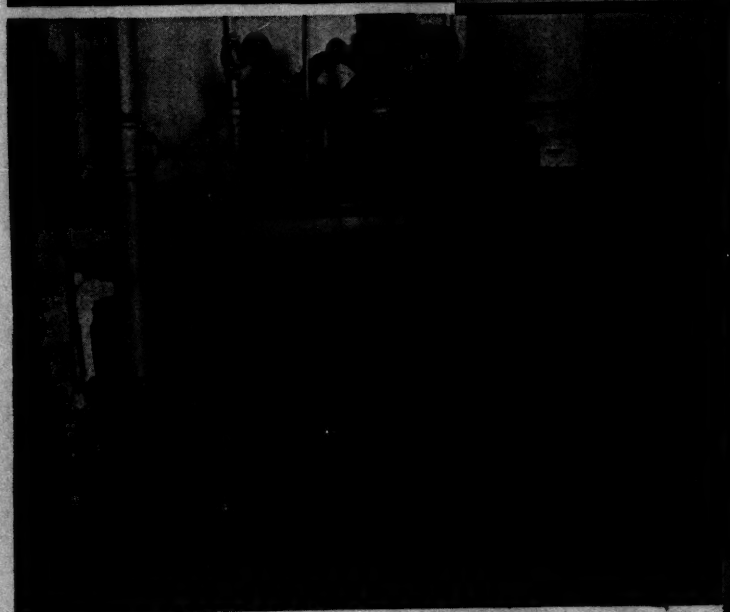

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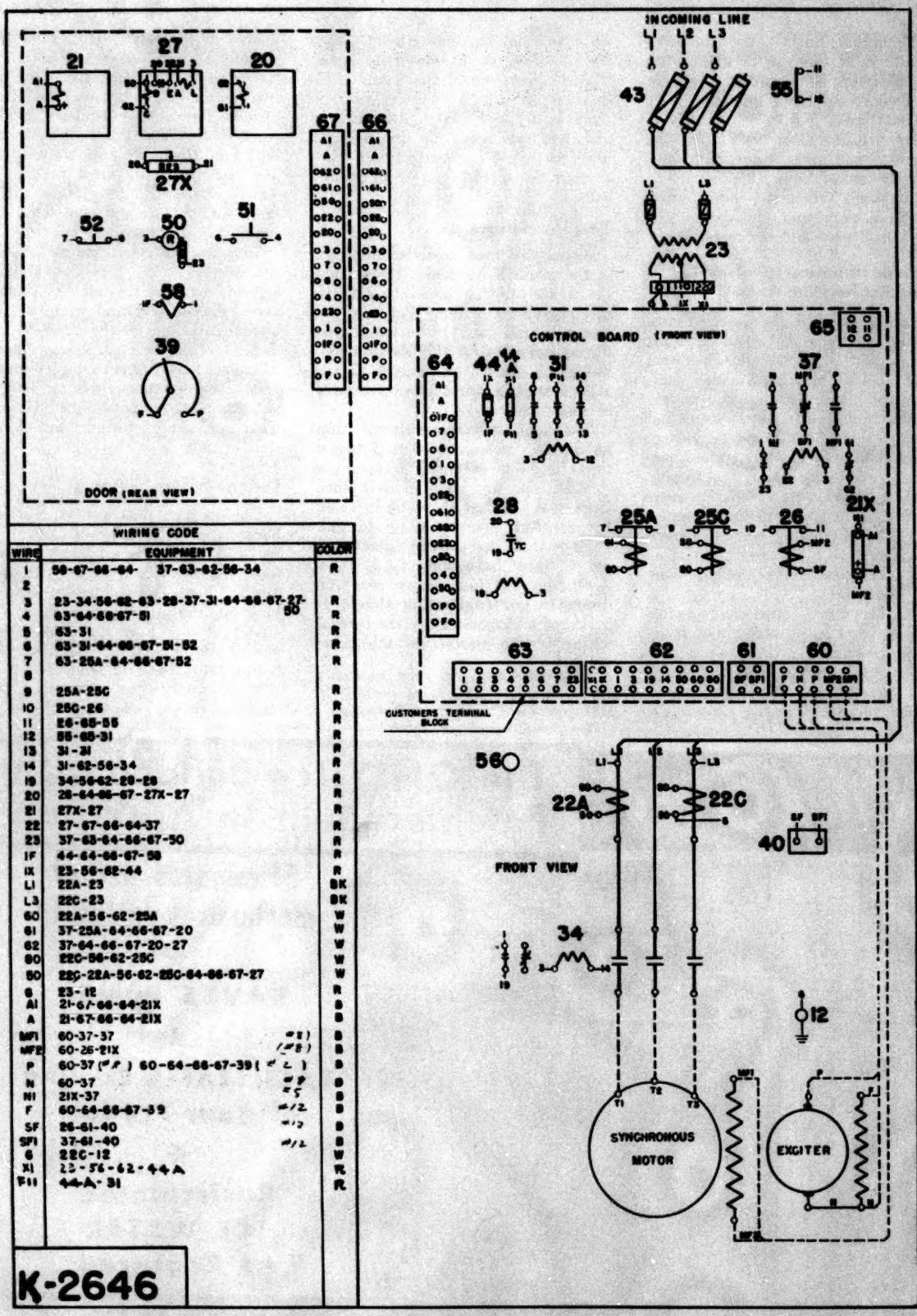

WIRING CODE

WIRE	EQUIPMENT	COLOR
1	58-67-66-64- 37-63-62-56-34	R
2		
3	23-34-56-62-63-28-37-31-64-66-67-27-50	R
4	63-64-66-67-51	R
5	63-31	R
6	63-31-64-66-67-51-52	R
7	63-25A-64-66-67-52	R
8		
9	25A-25C	R
10	25C-26	R
11	26-65-55	R
12	55-65-31	R
13	31-31	R
14	31-62-56-34	R
19	34-56-62-28-28	R
20	28-64-66-67-27X-27	R
21	27X-27	R
22	27-67-66-64-37	R
23	37-63-64-66-67-50	R
IF	44-64-66-67-58	R
IX	23-56-62-44	R
L1	22A-23	BK
L3	22C-23	BK
60	22A-56-62-25A	W
61	37-25A-64-66-67-20	W
62	37-64-66-67-20-27	W
80	22C-56-62-25C	W
80	22C-22A-56-62-25C-64-66-67-27	W
8	23-12	R
A1	21-67-66-64-21X	B
A	21-67-66-64-21X	B
MF1	60-37-37 (#1)	B
MF2	60-26-21X (#2)	B
P	60-37 (#P) 60-64-66-67-39 (#L)	B
N	60-37 #3	B
N1	21X-37 #5	B
F	60-64-66-67-39 #12	B
SF	26-61-40 #13	B
SF1	37-61-40 #14	B
8	22C-12	W
X1	23-56-62-44A	R
F11	44A-31	R

Fig. 3—Component layout and wireman's instructions for control pictured in Figs. 1 and 2 which shows position of parts, and their condition; i.e., the position of contacts (NO or NC) when de-energized. Numbers correspond to plastic plates on panel. Wireman runs wire No. 1 from terminals No. 58 to No. 67 to No. 66 to No. 64, using a red insulated No. 10 wire (see code at lower left). R indicates red, for low voltage control wiring; BK, black for high voltage control circuits; W, white for current transformer circuits; and B, blue for DC.

noted in the example preceding and repeat his steps up to #31, the control relay. If he finds the fuse (#44) is O.K., then he should check the position of such normally closed (NC) contacts such as overload relays, #25A and #25C. He should also check the position of squirrel cage winding protective relay (#26). Another spot to check is the main power fuse compartment door. Interlock (#55) is inoperative if this door is not securely closed.

Note that a visual observation is made of the relay positions. They are all of the manual reset type. If they are open, in an outward position, reset by depressing. If 25A or 25C were out, it would indicate an overload after some running time. Although this isn't the case with our subject operator, it could very well have happened. Any shift engineer experiencing such trouble on similar equipment would try to determine from the plant operating conditions, just what caused the overload.

Having reset the relays and meeting with failure again, our shift engineer will use the test wire provided for the purpose by his plant electrician. He proceeded to jump out all normally closed (NC) contacts in the safety circuits, between terminals 1 and 4 on terminal block (#63) (see Figs. 1 and 3)[3]. In this particular panel, they would be represented by D C B and remote stop in the control circuit pictured in Fig. 2.

Our operator depresses #51 with his test wire in place and finds his control is operative. When he removes the test wire, his machine stops. He then proceeds to jump out each NC contact individually. In this manner, he isolates the trouble, locates and corrects the derangement. If the safety circuit is a mercury switch, he can determine whether the circuit is open by merely observing the position of the mercury bulb.

Other Failure Possibilities

There are still other failure points which could have caused the original derangement that made our shift operator wish he could take off to the tall timber. Suppose relay #26 is open. This could indicate that compressor unloading devices were possibly not functioning. That would prevent proper synchronization as this is the squirrel cage winding protective relay. Overload on starting would trip it out. The mechanical equipment should then be checked to determine the cause of this starting overload.

Going back to the push button again, suppose the shift operator pushes it, the motor starts turning, but there is no reading on the DC ammeter. The motor will not synchronize. There could be two elements involved in this situation in addition to those previously explained:

(1) The field application relay #27 is not functioning. The engineer in this case can adjust resistance #27X, moving the sliding contact to cutout some resistance. Then the engineer would try again to start his machine. He will note that the relay closes quicker and his motor will start more easily and move into synchronization. This is common with situations of low voltage and heavy compressor starting loads.

(2) However, after adjustment of the resistance, if the relay is still not operative, its operation should be checked or observed through the glass cover. However, it should be noted that this is rather uncommon for trouble to occur here. If the field application relay is operative and the motor will still not start, then the next stop would be to check the field

[3]Terminal block (#63) is provided for hookup of external safety control wiring from the refrigerating appartus. For a wiring schematic of these circuits, see inset "Customers Saf-T Controls" Fig. 1.

contactor for an open coil. The shift operator can test this operation with his test lamp. Don't overlook the possibility either of DC excitation failure.

Direct Current Area

Basically, trouble shooting of motor controls involves an understanding of wiring and operation sequence; an understanding of Figs. 2 and 3. Testing by means of a lamp tests wire and voltmeter as appropriate in each of the three separate trouble shooting areas, should locate a derangement. A few of the suggestions in the AC area have been mentioned. The DC area is handled by a similar procedure.

Suppose in starting the motor again, either of our shift operators noted that the DC ammeter fluctuated considerably. He should shut the machine down, check contacts operated by NC relay #37, especially contact surfaces. He should also check his excitation generator brushes for dirt and other causes of poor commutation. For other symptoms, possible causes and cures, obtain a Control Trouble Shooting Chart from NAPRE Headquarters.

Current Transformer Area

Seldom is there any chance for failure in a current transformer circuit—the third area of trouble shooting. If the operator suspects something here, that is when he should call in the plant electrician, electrical service contractor or the manufacturer's representative. The operator should never open any part of this circuit (represented in the panel and on the diagrams by white wiring and labels) while the motor is running. To do so will only induce very high voltages. There could be several thousand volts potential. It is needless to remark here that such a potential would probably knock the operator right out of the area. That would be the least which could occur in way of personal risk.

Had our operator been asked to start the motor up following a general maintenance inspection or overhaul, there could be numerous other oversights on the part of the electrical maintenance gang which would have contributed to the failure of his electric motor drive. It is a good practice for the operator to look over the motor and motor control equipment thoroughly before starting, any time that he is called upon to do so following an overhaul. He should look over all clamps, screws, bolts and contacts to make sure that they are properly tightened. Visual observation will often detect an oversight. He should also inspect electrical contacts for evidence of burning or looseness.

Quite often a machine and its controls are reassembled in haste—to get the job done at the end of the work day and go on to other important work the next day. Therefore, the shift operator should be familiar with the plant preventive maintenance check list and take the time to make a visual inspection of the apparatus before he assumes responsibility for starting up the equipment.[4] Preventive Maintenance Check Lists can also be obtained from the NAPRE National Office.

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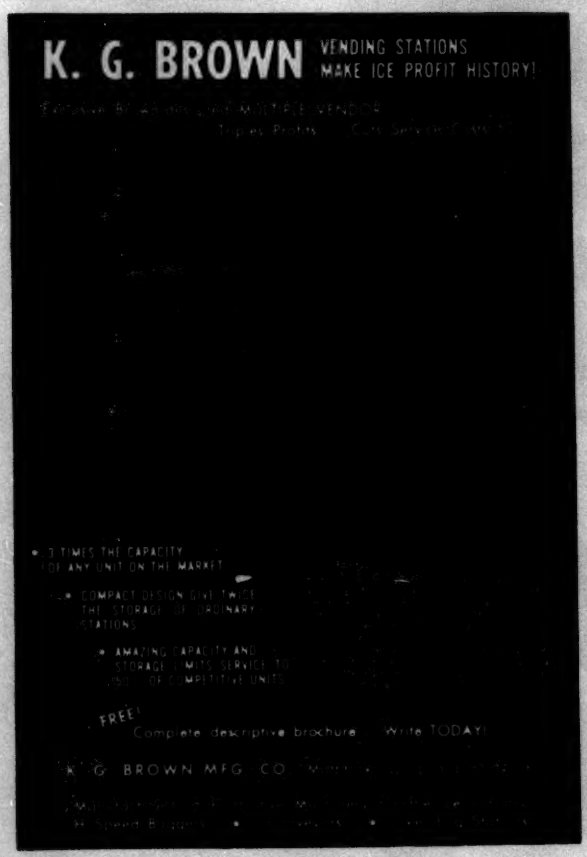
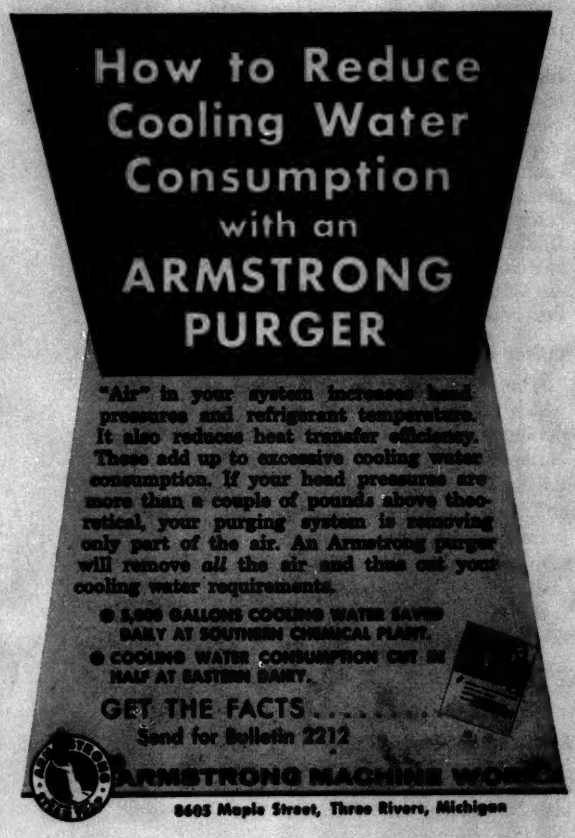
[4]See "Trouble Shooting on Motor Control Circuits", by Frank Vitt, NAPRE Operating Data Book, 1954; "Give Synchronous Drives their Proper Care", Robt. J. Crawford, May 1957, Industrial Refrigeration, page 35; and, ""Maintenance", June 1952, Industrial Refrigeration, pages 35 and 36.

Frozen Milk Chunks

FRESH milk is being shipped in frozen chunks to northern Canadian military bases. The first batch of 10,000 quart-size blocks went from Winnipeg to Fort Churchill under railway refrigeration and tasted fine when melted down at room temperature, it was reported.

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NAPRE

Question Box

The National Educational Committee, NAPRE, answers monthly in this column, operating problems forwarded by members. The Committee appreciates answers from the field. Address questions and answers to Prof. Harold P. Hayes, Dean of Engineering, State Polytechnic College, San Luis Obispo, California.

Challenges Corrosive Label For Refrigeration Grade NH3

QUESTION NO. 1197: Last year I noticed an advertisement in a national trade paper where an engineer was quoted as describing the refrigerant as being corrosive anhydrous ammonia. I have always been under the impression that ammonia contained in a refrigerant system was anything but corrosive. At least I have never heard of an ammonia system corroding from the interior. Would someone care to straighten me out on this matter?—C.T., Chicago.

ANSWER: Take a practical approach to this question, because the theoretical chemistry might get us into some needless arguments.

Corrosion may be defined in many ways but essentially it is the undesirable chemical destruction of a metal*. Some metals resist corrosion better than others. Therefore, when we say that a substance is corrosive we should say *how* corrosive it is and *to what* it is corrosive.

In the cases of anhydrous and aqueous ammonia, they have little effect on steel but attack copper quite severely. Therefore I would say that anhydrous ammonia can be considered corrosive—but only to certain metals.—H. P. Hayes.

Air Purification, Oxygen Replacement in Submersibles

QUESTION NO. 1198: The following questions are in regards to the air conditioning in atomic-powered submarines:
(a) How is the air purified, or filtered, so that they may remain underwater for indefinite periods?
(b) Can this type of equipment be made, or modified, or utilized in any way so that it may be economically practical in stationary equipment in buildings such as hospitals, hotels, stores?
(c) Is the heat of the foul air lost in the process? If not it certainly would be a fuel saver, particularly if it should ever reach the stage where it could be used in the average home. —L.O.G., New York City.

ANSWER: For security reasons, there is not much information available on the new atomic-powered submarines. On the basis of my experience with more conventional submarines, I make the following observations:

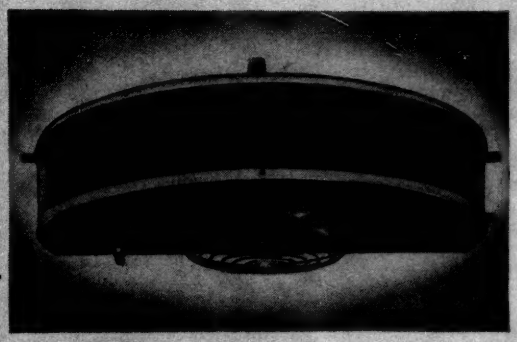
(a) Air in a submarine needs both purification and oxygen replacement. Purification to remove odors can be accomplished by the use of activated charcoal filters. Activated charcoal has the ability to remove odors very effectivelv.

Oxygen replacement is a little more difficult. During World War II, submarines carried containers of a chemical (lithium hydroxide, I believe) which had the capacity to absorb carbon dioxide. During long periods of submergence, the technique was to rip up mattresses and soak them with the chemical. The function of the mattress was to provide more surface contact area and therefore speed up the carbon dioxide absorption. Once a substantial amount of carbon dioxide was removed, oxygen stored at high pressure in cylinders was bled into the air.

I imagine that this process has been developed into a continuous or semi-continuous operation for the new nuclear powered submarines. You can picture a carbon dioxide absorbing unit through which the air is passed, and an oxygen releasing unit which replaces the consumed oxygen.

(b) Activated charcoal is now widely used in commercial applications for air purification. I do not see much point

* See "Corrosion & Protective Coatings", 1957 NAPRE Operating Data Book.



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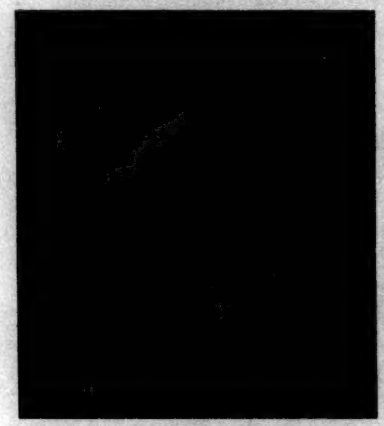
to the carbon dioxide absorbing units for commercial use because normal air needs no supplementary oxygen. Nature maintains the balance between carbon dioxide and oxygen.

(c) In analyzing applications for the heat of the foul air, bear in mind the temperature of the air. The lower the temperature, the more difficult it is to extract heat from it. For example, there are many applications for the extraction of heat from flue gas in boiler plants because the gas is at a fairly high temperature. There are not many applications for the extraction of heat from the air off air cooled condensers because the temperature is relatively low.

The amount of surface required to transfer heat when the temperature difference is small, is generally so costly that it is cheaper to lose the salvageable heat and supply heat directly from a cheaper source. Incidentally, heat transfer from a gas to a gas is much worse in this respect than from liquid to liguid —H. P. Hayes.

Cryotron Definition Asked

QUESTION NO. 1199: Some months ago you explained a transistor and we note that the Detroit Chapter had a speaker on the topic. Can you do as well for us on describing the cryotron? —N.M.D., Chicago.



ANSWER: A cryotron is basically a substitute for a vacuum tube. It has the advantage of being compact and inexpensive. It is looked upon by some electronic engineers as having great possibilities of application in the memory units of computers. In its most elementary form it consists of a straight piece of wire one inch long with a single layer control winding around it. The control winding provides a magnetic field which controls the super-conductivity of the one inch long wire.

Super-conductivity is a phenomenon which occurs in some metals at extremely low temperatures (-430F and lower). At very low temperatures some metals lose almost all of their electrical resistance and become super-conductors. The cryotron therefore controls the flow of electric current much as a vacuum tube will do and can produce what is known in electronics as current gain and power gain.

One application of a cryotron would be in the memory unit of a computer, where the unit is operated in a refrigerated atmosphere at -430F or lower. This approach promises amazing reductions in size of the computer.—H. P. Hayes

Notes Use of K Expression— Asks Comparative Definition

QUESTION NO. 1200: In many trade papers recently in connection with temperature there has been an expression K used instead of C or F to indicate the degrees of temperature. What does the K mean? How does it compare with C and F?—A.D.L., Member-at-Large.

ANSWER: The two commonly known temperature scales are centigrade and Fahrenheit. The formula for converting one to the other is

$$F = \frac{9c}{5} + 32$$

There are also two scales of absolute temperature, Kelvin and Rankine.*

$$\text{Kelvin} = K = C + 273$$

As an illustration, the boiling point of water at atmospheric pressure is:

$$\text{Rankine}^* = R = F + 460$$
$$F = 212$$
$$C = 100$$
$$K = 273$$
$$R = 672$$

The Kelvin scale has traditionally been the one used by scientists in their calculations.—H. P. Hayes

(Editorial Note: Rankine scale is based on absolute zero of the Fahrenheit scale.)

$-460°F = 0°R$; or $(tF + 460) = X°R$.

It corresponds with Kelvin scale based on the Centigrade scale.

Do not confuse Rankine with Reaumur, another thermo-scale invention by a Frenchman and shown on Page 10 of *Basic Refrigeration*.

Freezing point of $H_2O = 0°$ Reaumur
Boiling point of $H_2O = 80°$ Reaumer.

Seeks Condenser Hook-up In Adding Water-Saver to Plant

QUESTION NO. 1201: We have a cold storage plant with approximately 400 tons of refrigeration and are using the vertical type shell and tube condenser with well water of approximately 60°. We are contemplating adding 100 ton of refrigeration that must be connected with the existing compressor. Since we are now pumping all the water we feel is available in this area, we plan on using some sort of an evaporative type condenser. Since each engineer has a different opinion on how to connect an evaporative type condenser with a shell and tube condenser in the same system, we would appreciate your answering the following questions:

Can an evaporative type condenser be installed between the shell and tube condenser and the compressor, and discharge the gas into the top header of the shell and tube unit which would simply remove the super heat?

The other hook-up would be to connect the condenser with the discharge side of the compressor with the outlet hooked into the receiver with some sort of a trap between the evaporative condenser and the receiver.

We will appreciate any comments you might have on these two hook-ups which you think feasible.—L.A.W., Kansas.

ANSWER: More complete data is necessary in order to give specific answers; however, approximations will be given based on the following assumptions:

Well water temperature = 60F (given)

Present condensing pressure = 150 psi

Temperature of hot gas after compression = 180°F

Maximum outdoor wet-bulb-temperature = 75°F

It would be possible to use an evaporative condenser as a de-superheater placed between the compressor and the present shell and tube condenser, but not enough heat would be removed to meet your needs. Suppose that the de-superheater lowered the hot gas temperature from 180° to 100°F. The heat removed per pound of ammonia would be the enthalpy difference at (180°F and 150 psia) and (100°F and 150 psia),

After this de-superheating process the heat to be removed to cause condensation would be the difference of enthalpies at (100°F and 150 psia) and (100F @ psia saturated liquid),

or 645.9 = 130.8 = 515.1 Btu/lb.

The superheat would then be less than 10 per cent of the total heat which would need to be removed. This would hardly meet your needs.

The second hook-up using a new compressor connected to a new evaporative condenser with the latter outlet connected into the receiver through a trap is entirely feasible. A float trap with an orifice of sufficient size so that there would be only a few psi pressure drop through it (say 5 psi) would be suitable. During warm weather when the evaporative condenser would be in operation, its condensing temperature would probably be 100°F or above. Hot gas would blow through the evaporative condenser and receiver into the shell and tube condenser unless such a trapping device were used. If this occurred, the evaporative condenser would revert to being a de-superheater.

Before following either of these procedures, a close analysis should be made of the capacity of your present shell and tube condenser. It is possible that its load could be increased 25 percent without raising the condensing temperature above 100°F, corresponding to a condensing temperature of 211.9 psia or 197.2 psig. If this can be done without overloading the motors on the existing compressors, this would be the better procedure.—N. S. San Luis Obispo.

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Chemical Formula	CCl_3F	CCl_2F_2	$CHClF_2$	$C_2Cl_3F_3$	$C_2Cl_2F_4$
Molecular Weight	137.4	120.9	86.5	187.4	170.9
Boiling Pt. (°F) at 1 Atm. Pressure	74.7	—21.6	—41.4	117.6	37.6
Evaporator Pressure at 5°F (p.s.i.g.)	24.0*	11.8	28.3	27.9*	15.6*
Condensing Pressure at 86°F (p.s.i.g.)	3.6	93.3	159.8	13.9*	22.7
Freezing Point (°F) at 1 Atm. Pressure	—168	—252	—256	—31	—76
Critical Temperature (°F)	388	234	205	417	294
Critical Pressure (p.s.i. absolute)	635	597	716	495	478
Compressor Discharge Temperature (°F)	112	101	131	86	88
Compression Ratio (86°F/5°F)	6.24	4.08	4.06	8.02	5.33
Specific Volume of Saturated Vapor at 5°F (cu. ft./lb.)	12.27	1.46	1.25	27.04	4.04
Latent Heat of Vaporization at 5°F (B.t.u./lb.)	84.0	68.2	93.6	70.6	60.2
Net Refrig. Effect of Liquid—86°F/5°F (B.t.u./lb.)	67.5	50.0	69.3	53.7	43.0
Specific Heat of Liquid at 86°F (B.t.u./lb.°F)	0.21	0.24	0.34	0.22	0.23
Specific Heat of Vapor at Constant Pressure of 1 Atm. & 86°F (B.t.u./lb.°F)	0.13	0.15	0.15	0.15	0.16
Specific Heat Ratio at 86°F & 1 Atm. ($k = Cp/Cv$)	1.14	1.14	1.18	1.09	1.01
Coefficient of Performance	5.09	4.70	4.66	4.92	4.60
Horsepower/Ton Refrigeration	0.927	1.002	1.011	0.960	1.025
Refrigerant Circulated/Ton Refrig. (lbs./min.)	2.96	4.00	2.89	3.73	4.65
Liquid Circulated/Ton Refrig. (cu. in./min.)	56.0	85.6	68.0	66.5	88.7
Compressor Displacement/Ton Refrig. (c.f.m.)	36.32	5.83	3.60	100.76	18.78
Toxicity (Underwriters' Laboratories Group No.)	5A	6	5A	4-5	6
Flammability & Explosivity	None	None	None	None	None

*Inches of mercury vacuum.

COMPARE! Careful control at every step in the manufacture of "Genetron" Super-Dry Refrigerants results in products of highest purity, which are extremely low in moisture content and other undesirable impurities. Quality of current production consistently *surpasses* the rigid manufacturing specifications for these products. Write for important informative folder "Genetron Super-Dry Refrigerants."

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Allied Chemical

Detecting Refrigerant Leaks

QUESTION NO. 1202: Is there any practical means of detecting loss of halocarbon refrigerants (during the early phases of such leakage) in refrigeration equipment generally used for frozen food cases and meat chilling rooms in large food markets?—R.G.J., Chico, Calif.

ANSWER: A practical means for detecting such leaks is the usual Halide torch leak test. This consists of playing a special torch over the suspected sources of leaks and noting any discoloration in the torch flame. I would suggest a thorough check of your systems by this method and then actually institute a program of periodic routine checks.

If you are losing unusually large amounts of gas, it might possibly be from compressor shaft seals during extended shutdowns of the equipment. Check this point very carefully also.—H. P. HAYES

New Questions

Locating Leaks In Vertical Shell-and-Tube Condensers

QUESTION NO. 1203: Our plant is equipped with a bank of vertical shell and tube condensers of several different sizes. I suspect a leak in these condensers. How should I go about a test to see if I have a leak and how would I proceed to locate it?—M.R.H., N.Y.C.

Oil Substitution Effects

QUESTION NO. 1204: Please advise the effects 3050 oil (equivalent to SAE 20), would have if put in an ammonia refrigeration system where a Grade I oil should be used? The 3050 has a pour point of 0F, and has additives in same and is originally intended for medium duty motor sleeve bearings and fan bearings, while the Grade I oil is free of all additives and has a pour point of -25F.—A.G., San Francisco

Where Is Efficiency Gained—Low Side, or High Side?

QUESTION NO. 1205: I am trying to improve the overall efficiency of our refrigeration plant. Should I concentrate on the high side or the low side? Or should I look toward the compressor or expansion valves as my best bet? Is there any one place where I stand the best chance to gain in efficiency?—B.C.M., Chicago

Is Evaporative Cooling Considered Refrigeration?

QUESTION NO. 1206: Maybe you can help settle an argument for us. Who invented the first refrigeration machine? Can an evaporative cooler be classified as a refrigeration machine? I mean the typical home coolers used in the dry climates such as Texas.—A.D., Rio Grande Valley

Operating Steps When Receiver Glass Shows Clear

QUESTION NO. 1207: Picture a receiver in a sub-basement of an older hotel building—a hot humid congested area. What action should an operator take if the ammonia disappears out of the gauge glass. This happens frequently in warmer weather.—W.E.D., NYC.

What Methods Are Available For Rapid Produce Cooling?

QUESTION NO. 1208: We have been conducting tests and have found that rapid cooling of vegetables which are not immediately processed is to our advantage. We would appreciate your letting us know of any manufacturers or consultants who could help us with this problem.—B.E.B., New Jersey

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Dual Education and Exposition Features 48th NAPRE Meeting

INQUIRIES by the carton have come into NAPRE headquarters, to national officers, and to the Annual Meeting Committee during September. Chapters which have recessed for the "dog-days" have suddenly come to life. Their first demand is for convention news.

Nobody has goofed!! The Convention Committee has completed final plans and are dusting off the welcome mat in anticipation of the National Association of Practical Refrigerating Engineers Convention to be held Monday, November 18th through Thursday, November 21st in Chicago. Many reservations have already been received and this promises to be one of the Association's most memorable meetings.

NAPRE members from all parts of the nation are setting their sights on Chicago and the Sherry and Del Prado Hotels located on the south side of Chicago. Chairman Nicholas Downes reported that he had never seen such interest and enthusiasm. Quoting Nick: "We know that the registration will be unusually high this year because of the dual educational sessions scheduled and the opportunity for the members to visit the 10th All Industry Air Conditioning and Refrigerating Exposition to be held the same week at the Chicago International Amphitheater."

Tentatively the educational program schedule calls for these presentations:

Monday, November 18th: Welcome by the Hon. Carl A. Schroeder, Postmaster of Chicago. Mr. Schroeder is a great booster of NAPRE, his own Chief Engineer being President of Chicago Chapter. He has a definite message concerning the future of the practical refrigerating engineer.

The first Educational Session is on Food Preservation. Guy R. King, NAPRE's Educational Vice Chairman, will elaborate and expand on Chapter 13 of NAPRE's official text, BASIC REFRIGERATION, of which he is the author.

Tuesday, November 19th: Air Cooling Applications for Meat Plants is Dan D. Wile's topic. Vice President for Engineering, Recold Corporation (Industrial Member, NAPRE), Dan returns to the Chicago meeting and

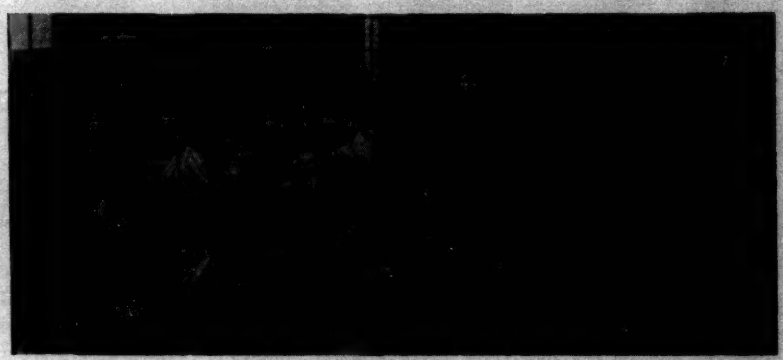


Fig. 1—Educational Sessions at NAPRE meeting will be set up conference style for easy note taking. The boss who finances a trip expects a written report! — Photo courtesy Hotel Sherry.

Fig. 2—Relaxation between sessions will hardly be in this attire, although Chicago has balmy Novembers. However, the skyline and enclosed portions of the roof garden will be just as attractive.—Photo courtesy Del Prado.

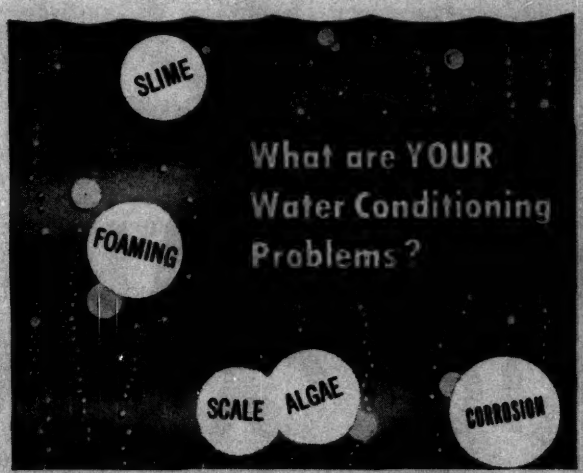
Fig. 3—Top award for convention fund participants is this Ben Hur freezer.

NAPRE educational platform for an encore to his 1953 paper.

Trouble Shooting on Refrigerant Flow Controls by Wm H. Krack, Sporlan Valve Company (Industrial Member, NAPRE), will review most of the problems occurring with air conditioning apparatus. A short discussion of ammonia controls will follow.

Multi-Staging of Refrigeration Systems by Will F. Stoecker, Ass't. Professor of Refrigeration, University of Illinois, and contributor to INDUSTRIAL REFRIGERATION (NAPRE's official organ) will enumerate advantages and review engineering principles behind two-stage refrigeration.

Water Conservation Measures is the fourth topic of the day. John Engalitcheff, Jr., President of Baltimore Aircoil (Industrial Member, NAPRE) will review the causes behind present water saving interest. Equipment for conservation of water and the principles involved in its operation will be reviewed. Engalitcheff will distribute a universal Counter-Flow Cool-



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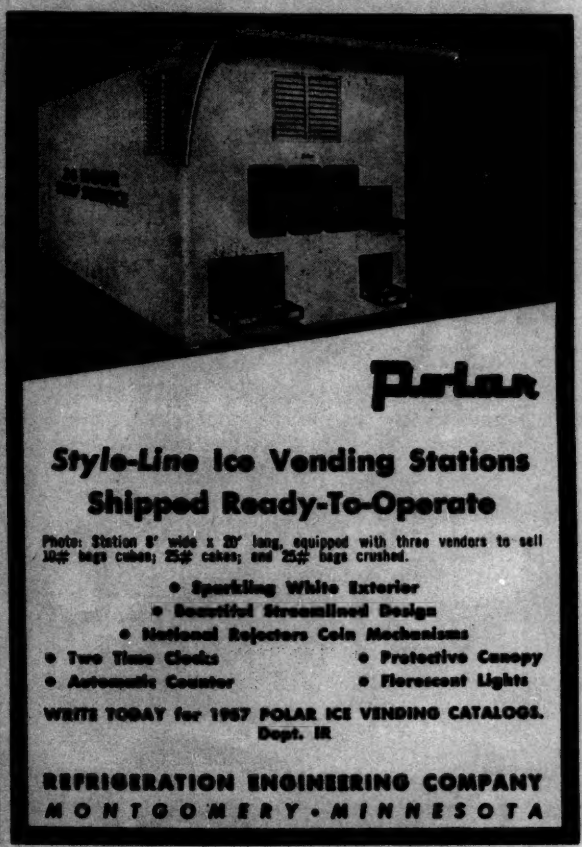

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Photo: Station 8' wide x 20' long, equipped with three vendors to sell 10# bags cubes; 25# cakes; and 25# bags crushed.

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- Beautiful Streamlined Design
- National Rejecters Coin Mechanisms
- Two Time Clocks
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- Florescent Lights

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REFRIGERATION ENGINEERING COMPANY
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ing Tower Selection and Performance Chart to all in attendance.

Wednesday, November 20th: Industrial Insulation of Piping Pressure Vessels features Dean Emerson, Jr., President of MMM, Inc. (Industrial Member, NAPRE). Dean will review new materials being introduced and their proper applications. Common faults, and protection of insulation against the elements and mechanical damage will be treated in this presentation.

Refrigeration and Air Conditioning Applications in the Pharmacal Plant—Water Problems is an encore also for Paul V. Northam, member-at-large and Chief Power Engineer of Miles Laboratories, Elkhart, Indiana. He will review briefly the three distinct refrigeration applications and systems in their establishment; their importance to the manufacturing process. Adding interest will be the account of this firm's growing water problem.

Third subject of the day is Ammonia Recirculation and its Application to The Small Meat Freezing Plant. Joseph Greenspahn, Chief Engineer of Frigidmeats, Inc. is a Chicago Chapter member. He will describe modifications to their plant which include ammonia recirculation system; the economic advantages gained thereby and some of the headaches which were cured.

Controls for the Modern Industrial Heat Pump Installation is an extra feature. Howard A. Wolfberg, York Corporation, a member of Chicago Chapter, will review the many control systems involved in the water source 2,000-ton heat pump in the Southdale Shopping Center, Minneapolis. Wolfberg simplifies what many consider to be elaborate systems.

Thursday, November 21st: Application of Centrifugals to Industrial Ice Manufacturing was previewed last year at Detroit. Robert F. McKee, Mechanical Engineer, Pacific Fruit Express Company, San Francisco Chapter member and Vice-President, describes PFE's Ogden plant which is unique, not only in its application of Refrigerant-12 centrifugal compressors, but also differs from the conventional ice plant in several other major aspects which may well be considered revolutionary.

Harold P. Hayes, NAPRE's Educational Chairman and Dean of Engineering, California State Poly. College in San Luis Obispo, Calif., will make a special presentation, topic of which will be announced on completion of a survey being made at the present time.

Clinic Programs Daily

Chapter Clinics will be held daily, Tuesday through Thursday, prior to the education sessions. Chapter delegates are urged to submit topics in advance to Vice-President Chase, who will assign them to the most experienced NAPRE leaders. Topics scheduled tentatively for discussion are:

Tuesday: The establishment of educational and speaker programs for your chapter, with LeRoy Etzel, Guy R. King and Alvis J. Clay.

Wednesday: Getting the most out of your NAPRE publications, featuring Harold P. Hayes, Erich B. Utescher, J. Richard Kelahan.

Thursday: Membership conservation and new membership promotion through industry relations; Roy T. Burns, George N. Paulick, Lawrence H. Benedict.

Time changes and shifting of subjects are in order, of course, to accommodate speakers who will be involved in many activities at that time. As can be seen, the subjects are of an educational nature and will be of great benefit to visitors as well as

(Continued on page 64)

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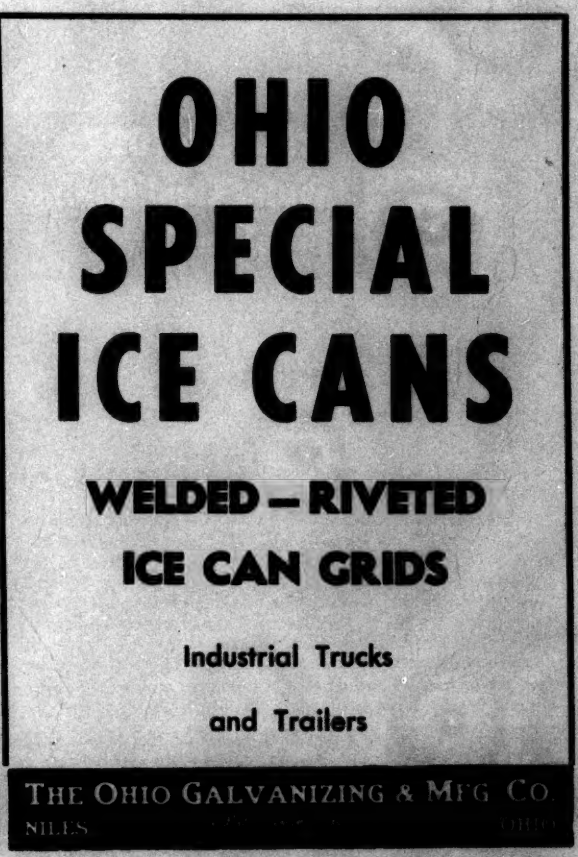


International Conference Hears Papers On Low Temperature

THE temperature outside the University of Wisconsin theater, Madison, Wis. was a sultry 85F but inside nearly 400 top scientists from 16 counties were applauding a jovial, German-born Oxford University physicist who had achieved the coldest temperature yet made by man.

The University of Wisconsin event was the opening general session Monday of the Fifth International Conference on Low Temperature Physics and Chemistry. The conference was held August 26-31. The man was Nicholas Kurti of Clarendon Laboratories, Oxford, England, who had just received the first Fritz London award for his pioneer work with magnetic fields in approaching the bottom temperature limit, the point where it can get no colder. In presenting Prof. Kurti with the $1,000 honorarium award committee chairman J. G. Daunt, dean of chemistry and physics at Ohio State University, said it was "for the person who has contributed most to expanding the basic knowledge of low temperature physics."

Following the presentation, Kurti explained to his colleagues from 15 nations how his research group had cooled a copper rod to just 10 millionths of a degree above absolute zero. (Absolute zero is about 457 degrees below Fahrenheit zero.) Continuing his talk on "Nuclear Orientation and Nuclear Cooling", Kurti described the technique he had evolved using magnetic fields to align the nuclei of atoms. After conducting away any heat created in the aligning process, the magnetic field was suddenly removed and the copper rod cooled still more as the nuclei reoriented themselves.

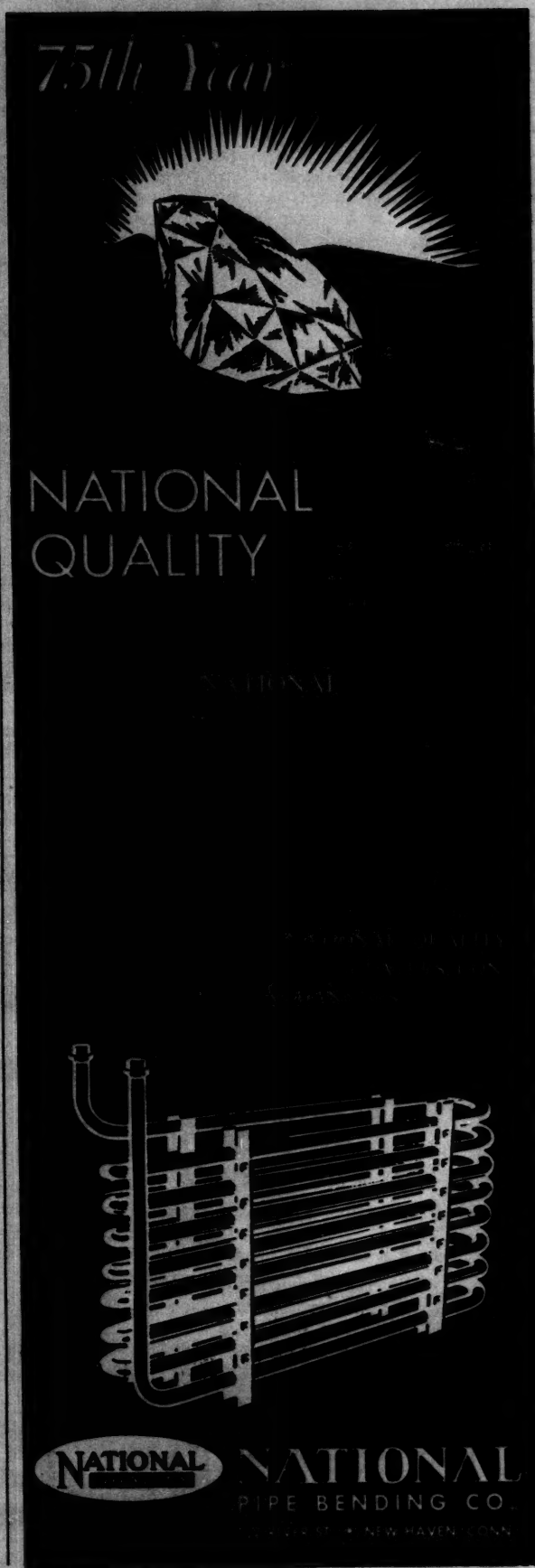
In a word of welcome which opened the general session, UW Vice-Pres. Ira L. Baldwin told the conference members that "the field of low temperature physics well illustrates the principle that in scientific research, the returns are in proportion to the investment." Baldwin went on to say: "Here we have a field, explored by only a few scientists until a few years ago, in which enormous advances have been made, both in furthering our understanding of the nature of matter, and in the improvement of tools of use in many fields of research."

Superconcentrated Frozen Orange Juice

THE negative side of this very important question is effectively presented by A. W. Langfield, past president of NFFDA, in the Latter's Bulletin for July 26. Concentrates at the 4-1 and 5-1 level are undergoing investigation in Florida to determine whether or not lower costs and greater stability can be realized.

Mr. Langfield makes several points: (1) Changing an established market and practice would be risky and expensive; (2) Use of smaller can would look like less value to many consumers; (3) Use of the present can would raise a problem of extra juice for family consumption; (4) Consumers do not like a sudden change, and a change to superconcentrate would be abrupt; a gradual change is impossible.

With regard to stability, Mr. Langfield makes this forceful remark: "Too many companies have tried to achieve low-cost distribution and in the process they have bought 'cheap' distribution. As with anything else cheap, it ultimately comes to a very high price . . . So long as present practices of marketing continue, I do not believe any degree of greater stability will cure this evil. Certainly it will become known that superconcentrate is more stable; therefore, it will take a greater beating and let's not make any mistake about that . . . TRRF Bulletin.



(Continued from page 62)
members. The sessions are scheduled for mornings only, to leave the afternoon for tours and trips to the All Industry Show at the Amphitheater. Another extra feature this year will be two sessions running at the same time where members may select the topic which would be of the most benefit to them; thus, conserving time. Most talks will be reproduced and distributed to registered guests and members in attendance. NAPRE will also have its own exhibits of industrial equipment and supplies—a regular and annual feature.

Selection of Plant Visits

Field trips will be offered in great variety to convention attendants. Included is a trip to the Illinois Bell Telephone Co. facilities which presents an industry that requires refrigerated cooling to control humidity and temperature for operation of its automatic dial equipment. Joe Farrell, Chief Engineer of Continental Freezers, will be the guide conductor for the trip thru his modern freezer warehouse. It is one of the best examples of a modern food storage plant for frozen merchandise. Another tour of a modern installation requiring refrigeration will be to the Albert J. Swill Co., one of the largest suppliers of malt to the brewing industry.

Still another trip offered is to the Merchandise Mart which has more office floor space than any other building in the country. You will see how the refrigeration system is designed and maintained in this huge building. St. Peters Church and the Prudential Building are other outstanding plants where members can see new and unusual refrigeration and air conditioning plants.

Social Activities

Not all of the convention will be devoted to business. Thursday will be the day of the annual installation of officers and will be held in the Crystal Ballroom of the Del Prado Hotel. Much attention has been devoted to the ladies and under the capable leadership of Mrs. Marge Richards, Chairman of the Ladies Committee, many trips and entertainments have been planned. A tentative schedule for their enjoyment will include a tour of the Art Institute where a Picasso exhibit will be held, brunch and a film on jewels of the century, a luncheon at the Kungsholm Scandinavian Restaurant with their well known puppet opera, combined with enough free time for individual shopping in the Loop and sightseeing.

Rolling out the red carpet of welcome will be Roger Hart of the Howe Ice Machine Company. Roger, Chairman of the Reception and Registration Committee, has definitely worked hard to make the visitors' stay in Chicago one that will be long remembered. Explained Chairman Hart, "This will be the first look at Chicago for some of our visitors and we want to make each and every one feel that there is as much friendliness here as they would find in their local cities".

Charles Taylor, United States Cold Storage Co. has reservation forms out to the members. Accommodations will be at the Hotel Sherry, 1725 E. 53rd, and the Del Prado Hotel, 5307 South Hyde Park. The Del Prado and Sherry were selected to give the members a peaceful and suburban atmosphere yet allowing them the convenience of short traveling distance to the Loop and the All Industry Show. Both hotels are on Lake Michigan with views of both the north and south fingers of the beautiful Lake Shore Drive. Parks and benches surround the site of the convention and ample parking space is available for

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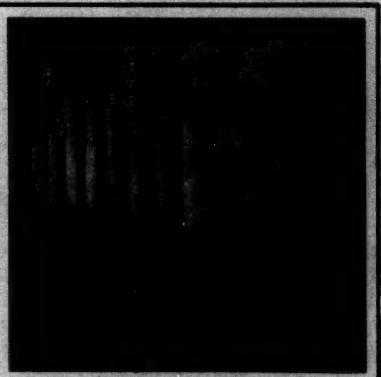

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the members who wish to drive. Bill Cody, Chief Engineer at the Hotel Sherry and Wm. Castle at the Del Prado extend their personal invitations to all friends and fellow members.

Others working hard to make the members visit worthwhile and beneficial are these committee chairmen: Nick Downes, Illinois Bell Telephone Co., General Chairman; Bill Richards, H. A. Phillips Co., Finance; Dick Kikkebusch, Illinois Bell Telephone Co., Field Trips and Transportation; Charles Fuhry, Saunders & Co., Entertainment; and Joe P. Wimsatt, Dyfoam Corporation, writes the publicity.

Freezer Participation Award

Financing of transportation and educational costs involved has been a major hurdle. Chicago has had wonderful assistance from all chapters in disposing of donation tickets for that fund. As a result, some fortunate members will walk away with valuable participation prizes. Top of the list is a beautiful Ben Hur freezer donated by member Ward C. Stoner of this Milwaukee manufacturing firm. Stoner was co-founder of that Wisconsin Chapter, with the late Prof. H. G. Venemann.

Chicago Chapter of the NAPRE hasn't goofed!! They have a well planned program directed towards the members. The information gained from these educational sessions will well be worth the time and trouble to attend the convention November 18th through the 21st. The committee hopes you will not "goof" by missing this outstanding convention.

NAPRE Introduces 1957 Operating Data Book

THE 17th edition of NAPRE Operating Data Book made its appearance in August. This annual publication of the Association contains 10 technical articles, a report on a training program and an editorial. The publication was circulated free-of-charge to all classes of membership in the Association. Other copies may be purchased directly from NAPRE or from Nickerson and Collins Company at $5.00 per copy.

Articles contained in the 17th edition include the following: Construction of Pressure Vessels, Edw. P. Callanan; Maintenance and Service Contracts, Guy R. King; Nuclear Power Development, Ruble A. Thomas; Water Vapor Absorption Plants, Thomas E. Kurtz; Servicing Mechanical Refrigerator Cars, Gerald Ervin Hicke; Food Freezer Evolutions, Fred L. Young, Jr.; Corrosion and Protective Coatings, Harold P. Hayes; Vacuum Cooling, Chester R. Anderson; Finned Evaporators, H. J. Taylor; New Refrigerants—Their Characteristics, Identity and Applications, Guy R. King.

Erich B. Utescher, Chairman of NAPRE's Publications Committee, indicates that the Association has had numerous requests for reprints of the Guy R. King paper on new refrigerants. He has announced that reprints of the King paper are available to non-members at $1.00 per copy. Additional copies to members may be obtained through the NAPRE office at a 50 percent discount.

NARW-TRRF Executive Committees Joint Meeting

THE Executive Committee of the National Association of Refrigerated Warehouses and The Refrigeration Research Foundation held a joint meeting this month at the Sherman Hotel in Chicago. This was the first such combined meeting of the two groups and extensive discussions were held on industry problems and developments. Prominently on the agenda was the increasing danger of private cold storage space construction to production, in-transit and distribution public refrigerated warehouses. Presiding jointly were presidents Sheffield A. Kadane (NARW) and Garth A. Shoemaker (TRRF).

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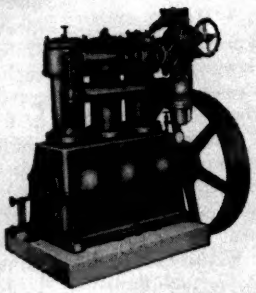

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Refrigeration and Air Conditioning Industry in Engineering Recruiting

FOR many years, national defense industries have topped all others in recruiting efforts for engineers graduating from the leading technical colleges and universities. One exception to the rule reported this year came from Dean of Engineering, Harold P. Hayes of California State Polytechnic College, San Luis Obispo. At this particular school, there was nearly four times the interest in refrigeration and air conditioning graduates than in graduates of other departments, including aeronautical and electronic specialists.

Recruiting statistics compiled by Cal Poly for the 1956-1957 school year showed that 46 companies visited the campus and conducted interviews with the refrigeration and air conditioning engineering graduates. According to Hayes, there were 21 graduates with AC&R qualifications, indicating a ratio of better than two companies competing for the services of each engineer.

According to the statistical report, 18 of these companies specifically asked for interviews with the AC&R students, while the other 28 companies interviewed these graduates in addition to other engineering majors.

The highest salary offered to an AC&R major was $510.00 a month; the lowest was $425.00 and the average was $451.00 per month. The report noted that the highest average for any graduate of the various engineering departments, was not the air conditioning and refrigeration classification, in spite of the keener competition for these graduates. Table 1 shows the comparison of salary offers with other industries.

The recruitment report indicated that a total of 150 companies visited the Cal Poly campus to interview 229 engineering graduates. Further, the report indicated an average of four job offers per engineering graduate. One-fourth of the AC&R engineers accepted offers with firms providing additional training programs in the Eastern states.

TABLE 1 – Comparison of Starting Salaries Offered to Recent Engineering School Graduates

School	Average	High
Electronic	$488	$569
Aeronautical	470	555
Mechanical	467	569
Architectural	466	500
Electrical	462	550
Air Conditioning	$451	$510

Ice is Best For Fresh Fish

WHILE millions of dollars a year are spent by Canada's three million fishermen on equipment, travel and accommodations to indulge in their favorite pastime, Fred Wooding, Information Director of the Federal Fisheries Department says that many do not know how to handle their catch to keep it fresh and wholesome. Mr. Wooding said that all too often the gift brought home from a fishing trip was partly spoiled and unfit for anything but the garbage can.

Fish deteriorates rapidly because of bacteria lodged in its intestinal tract, on its skin and its gill coverings. The bacteria multiply quickly and could spoil a fish in thirty-six hours.

There are other decay-causing factors. Scientists found that the energy lost by a fish in its death struggle upset

the chemical balance in its muscle, and hurried the onset of rigor mortis.

Mr. Wooding advised that anglers kill their fish as soon as they were caught, dress them, pack the body cavities with finely crushed ice and then pack them in more ice in an insulated container. He said fisheries scientists were trying to find a fish preservative that would have practical application for anglers.

Dr. Hugh Tarr, Director of the Fisheries Research Board's technological station at Vancouver, developed an aureomycin compound used at sea under rigidly controlled conditions by commercial fishermen.

The compound is an antibiotic. The Health Department's Food and Drug Administration did not approve sale of the compound to anglers because careless use of the antibiotic could be harmful to human health.

Commercial fishermen dip their catches in a solution of water and aureomycin compound, or dust the powder compound on the packing ice.

COMING CONVENTIONS

FLORIDA ICE ASSOCIATION
October 6-8, 1957
Roosevelt Hotel, Jacksonville, Fla.
Muriel Washburn, Exec. Secy.

NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS
October 17-19, 1957
Grand Pacific Hotel, Bismarck, N.D.

NATIONAL SAFETY CONGRESS AND EXPOSITION
Sessions on Industrial Safety
October 21-25, 1957
Conrad Hilton and LaSalle Hotels, Chicago, Ill.
R. L. Forney, General Secretary

SOUTHWESTERN ICE MANUFACTURERS ASSOCIATION
Conference of Engineers
October 23-24, 1957
Gunter Hotel, San Antonio, Texas
P. A. Weatherred, General Counsel

NATIONAL ASSOCIATION OF ICE INDUSTRIES
November 12-15, 1957
Statler Hotel, Detroit, Mich.
Wm. T. Jobe, Exec. Vice-pres.

CANADIAN ASSOCIATION OF ICE INDUSTRIES
November 14, 1957
Statler Hotel, Detroit, Mich.
Mildred Croft, Exec-Secy.

AMERICAN SOCIETY OF REFRIGERATING ENGINEERS
November 14-16, 1957
Shoreland Hotel, Chicago
R. C. Cross, Executive Secretary, New York City

NATIONAL ASSOCIATION PRACTICAL REFRIGERATING ENGINEERS
November 18-21, 1957
Hotels Del Prado & Sherry, Chicago
J. R. Kelahan, Secretary

AIR CONDITIONING & REFRIGERATION EXPOSITION
November 18-21, 1957
International Amphitheatre, Chicago, Ill.
George Mills, Show Director

SOUTHWESTERN ICE MANUFACTURERS ASSOCIATION
December 1-3, 1957
Stephen F. Austin Hotel, Austin, Texas
P. A. Weatherred, General Counsel

DELTA STATES ICE ASSOCIATION
December 8-10, 1957
The New Montelone, New Orleans, La.
Edna Vaughan, Secretary.

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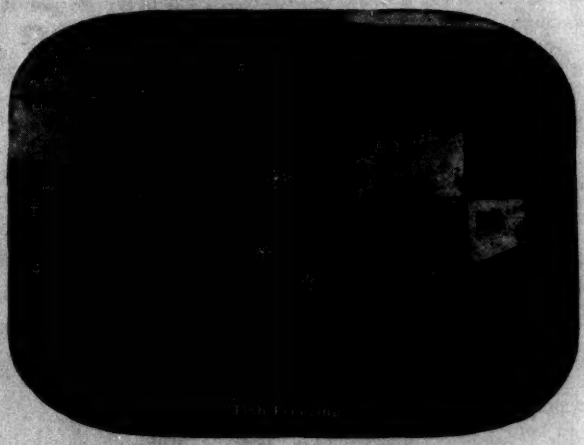
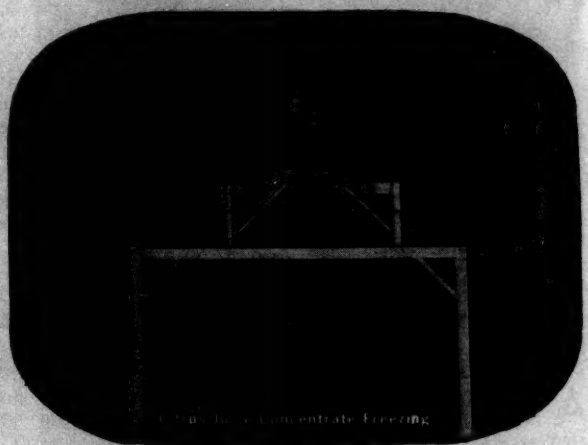


★ *Never a rise in temperature*

★ *Save Power... Reduce Costs*



Write for Niagara Bulletin 105

NIAGARA BLOWER COMPANY

Dept. IR10, 405 Lexington Ave. New York 17, N. Y.

District Engineers in Principal Citin of U. S. and Canada

Booster System Helps Meat Packer Cut Costs

Continued from Page 18

is at a temperature of minus 30F. and a pressure of 1.6 inches mercury, vacuum. The rotary compressor receives this refrigerant gas and pumps it to a discharge pressure of 20 psig. But it also superheats the refrigerant gas to about 185F., which is too high to be released into the main house suction line. The discharge line, therefore, is routed through the intercooler, (see again Fig. 2), where it is lowered to 5F. while still maintaining its 20-pound pressure. This temperature and pressure matches that averaged in the house main suction line.

The low temperature room has been successfully freezing and storing meat since the addition was put into operation in August, 1956. The room can hold 150,000 pounds at one time. Average storage period is 30 days, never more than six months. A first in, first out method of storage is used, so the meat is all about the same age at any one time.

The biggest advantage of the new system has been that Falters are able, at a cost factor that makes it practical, to keep meat frozen and available from storage when needed. Slaughtering line is set up when the firm needs it for a new consignment of hogs, not when they have an incoming order to fill. This has cut costs of operation, and is paying off the cost of the extra equipment.

Maintenance and downtime costs have not risen, even though the new room installed adds a high demand load on the refrigerating system. The FES-Fuller rotary compressor that is now in use shows evidence that overall maintenance costs will be appreciably reduced.

The addition is of poured concrete. Walls of the cold room are cork lined and the floor is a sandwich of two layers of concrete with cork between. The thickness of the insulation for the floor is 8 inches; for the walls and ceilings 6 inches. The interior finish is plaster. Pipe coils are located under the sandwich-type floor to eliminate buckling from frost.

New Cold Storage Room

A NEW cold storage room is being built at the plant of the California Grape Products Corporation northeast of Delano, Calif. It will provide for storage of a half million gallons of wine. The cold room, to be completed this Fall, will have an even temperature to maintain the quality of the wines, regardless of the season.

From Boilers To Boosters

Continued from Page 25

(6) Electrically driven heat pumps are not at the mercy of complicated labor and transportation difficulties for delivery of fuel—it comes in by wire.

(7) Expensive water treatment and dependence on the human element to protect boilers are eliminated.

With readily recognized long range fuel economy advantages, and the utility load factor improvement, heat pumps will be applied more and more. Cooperative effort of the utility companies and equipment manufacturers can hasten that development.

Two Chicago Dairies Change Ownership

AFTER serving the institutional field for 78 years, Theodore Renz & Co., Chicago dairy farm was purchased by the Dean Milk Co., Chicago, in August. Earlier in the month a group of dairy vendors formed a corporate enterprise and purchased the Union Dairy Co. plant which had been idle for about a year and a half. The new plant was renamed The Twin Oaks Dairy Co.

Announcement of the acquisition of Renz Dairy by Dean Milk Co. was issued by Sam E. Dean, Chairman of the Dean Milk Co., and Oscar Kuehn and George Renz of the acquired firm. The statement did not reveal details of the merger other than to indicate that equipment and personnel would be taken over by the Dean company.

The Twin Oaks Dairy Co. at 2621 West Wilcox in Chicago is headed by Henry G. Duda, an independent milk vendor in Chicago since 1931. Forty-eight men, including Duda, who have delivered milk from their own trucks as vendors on routes developed by themselves over the past 26 years formed the Twin Oaks enterprise 14 months ago on money they had saved or borrowed. Their business is incorporated as a quarter million dollar venture.

The new vendor owners of the Twin Oaks plant did 60 percent of their renovating and remodeling themselves. Some $120,000.00 of new equipment was installed, including conveyors, washers, fillers, pasteurizers and case stackers. The vendors still deliver milk to their 300-odd customers, but now as dairy plant owners.

The purchase of the Renz plant by Dean Milk Co. marks the entrance of the latter firm in the institutional side of the dairy business. Previously Dean has limited its activities exclusively to retail and chain store trade.

Atomic Preservation Of Foods Still Long Way Off

THE widespread commercial use of atomic energy in the preservation of perishable foods is "a long way off", according to Dr. H. C. Diehl, Director of The Refrigeration Research Foundation, Colorado Springs, Colorado. In response to an inquiry from S. A. Kadane, president of the National Association of Refrigerated Warehouses, Dr. Diehl said:

"Although continual scientific progress is being made on the important subject of irradiated foods, the widespread commercial usage of atomic energy in preserving perishable foods is still a long way off."

Dr. Diehl said further that there has been no marked change in the attitude of scientists, food technologists and manufacturing firms since the 1956 "canvass" was made by TRRF and the results of which were not optimistic for the commercial use of irradiated foods in the near future.

"The scientific progress that is being made is highly significant," stated Dr. Diehl, "but the economic and engineering aspects of these advances still remain to be evaluated and developed in an industrial sense, to say nothing of the public health aspects of eating irradiated foods, which may not, however, have any adverse significance for the ultimate consumer.

"TRRF says again it is not likely that irradiation in any foreseeable future will eliminate the need for refrigeration of all or many commodities. In fact, when pasteurizing doses are used to control surface bacterial growth, as seems much more feasible at present, the product then requires subsequent refrigeration at cooler level.

"Some commodities," Dr. Diehl concluded, "may acquire certain properties or have certain characteristics preserved by irradiation which, perhaps together with the product's value, will justify commercial irradiation in the future."

Florida Ice Convention

THE thirty-second annual convention of the Florida Ice Association will be held at the Roosevelt Hotel, Jacksonville, Fla., October 6-8. An interesting business and entertainment program has been arranged. Experienced ice men from Florida and adjoining states will share their experiences in conducting a successful ice business.

News of PEOPLE

Another Hayes Appointed To Cal Poly Staff

J. A. Hayes

LATE in August, Dean Harold P. Hayes, School of Engineering, California State Polytechnic College, San Luis Obispo announced that J. A. Hayes, St. Louis, Mo. had accepted a teaching position at the college. The new appointee most recently with the St. Louis Board of Education is a member of NAPRE, and has been actively employed as a refrigeration engineer since 1935. His appointment to the Cal Poly faculty brings the total number of NAPRE members at the San Luis Obispo school to four. National membership chairman, George N. Paulick, guessed that Hayes transfer to California would establish some kind of a record nationally with regard to the number of NAPRE members in any one college.

DAVE H. SANDERS has been appointed manager of cold storage operations for Omaha Cold Storage Company, according to an announcement by F. K. Crosby. The cold storage company is a division of Ocoma Foods Company. Mr. Crosby is president of both companies. Mr. Sanders, who has been assistant storage manager for five years, succeeds the late Julius L. Gagini. Howard M. Jacobsen will become customer relations manager in addition to continuing as general traffic manager of the storage company.

PHILIP P. GOTT, President of the National Confectioners Association, was presented recently with an Award of Appreciation by the Quartermaster Food & Container Institute for "Energetic and unselfish assistance to the Quartermaster Corps in the fulfillment of its mission". Mr. Gott has worked intimately with The Refrigeration Research Foundation in the development of co-sponsored projects on refrigerated storage of candies.—TRRF Bulletin

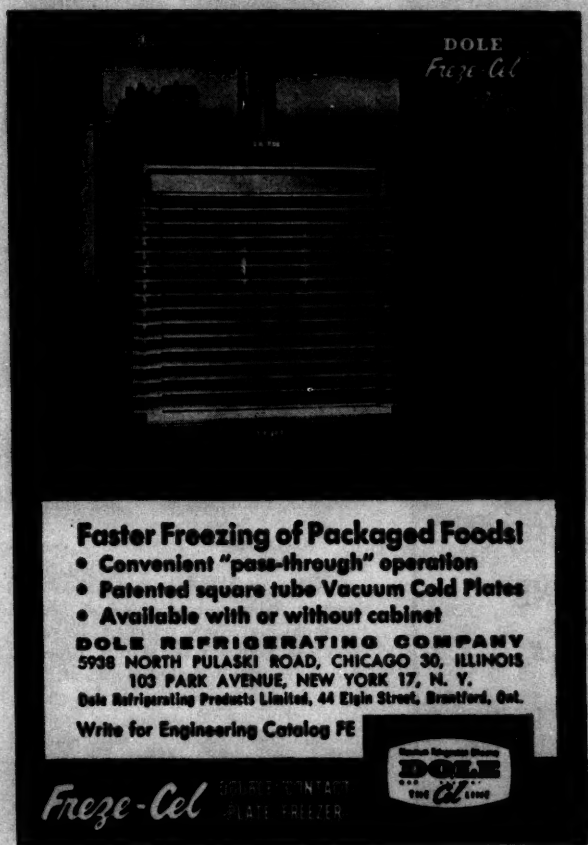
GEORGE H. BAILLIE of Toronto, vice-president of the Canadian Pacific Railway's eastern region was re-elected president of the New Brunswick Cold Storage Company at the annual directors' meeting.

DEATHS

Edward A. Tebbets

THE DEATH of Edward A. Tebbets occurred at his home in Clearwater, Fla., July 21, after a long illness. Mr. Tebbets was associated with the ice business for more than 60 years, first with the Henry Vogt Machine Co. of Louisville, Ky., and in 1906 he became chief engineer of the Colonial Ice Company of Pittsburgh, Pa., the Crafton Ice Company, Crafton, Pa., and the Winter Garden Ice Skating Rink of Pittsburgh. He was owner-operator of the Coraopolis, Pa. plant until 1945, when he retired. He has made his home in Clearwater since 1947. Mr. Tebbets was an active member of Pittsburgh Chapter, National Association of Practical Refrigerating Engineers, until his retirement and maintained his interest in the ice industry until his death.

MRS. T. G. ROGERS, wife of the founder of the Ontario Ice Association, later enlarged to the Canadian Association of Ice Industries, died recently, after an illness of some time.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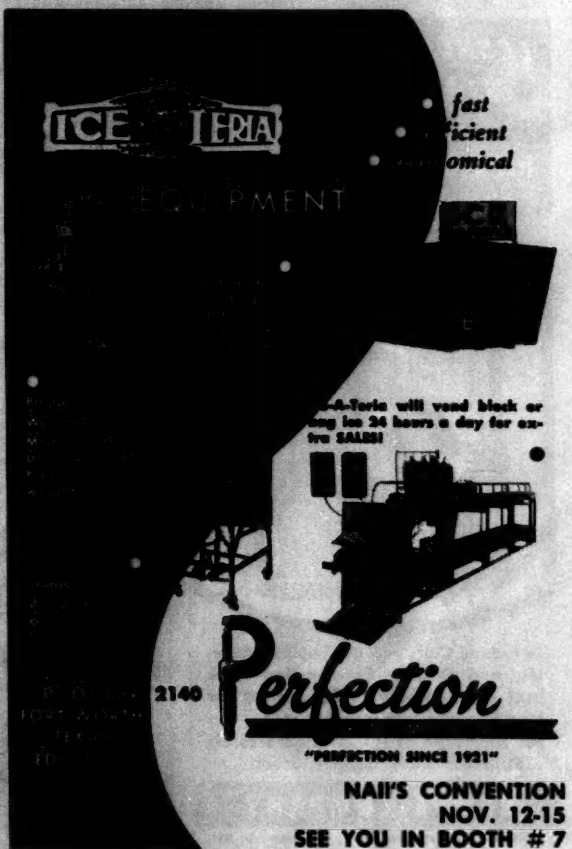

MANUFACTURERS' NEWS

Munce Joins Noonan

MARSHALL G. MUNCE, formerly a vice-president of York Corporation and vice-president of the York Division of Borg-Warner Corporation, has been appointed sales manager of R. S. Noonan, Inc., York, Pa. contractors and engineers. Announcement was made by R. S. Noonan, president.

As sales manager of R. S. Noonan, Inc., Mr. Munce will concentrate on industrial construction in which the York contracting firm specializes. He will also be engaged in the operations of R. S. Noonan's division for thawing frost-heaved floors in frozen food warehouses.

Mr. Munce was associated with the York Corporation for more than 25 years. He served as a sales engineer for many years, later managed York's Washington office and their British subsidiary at London, England. Subsequently, as special assistant to the president, he organized York's participation in special munition and war work. In 1948, he became vice-president in charge of Public and Trade Relations, and later of Marketing Services.

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American Blower Fall Training School

SCHEDULE of classes for their 1957-58 Air Conditioning Training School has been announced by J. W. Hosler, manager, Commercial Air Conditioning products department for American Blower Division of American-Standard. The school's second year of operation began with a service course on September 30, 1957, and will continue on schedule through May 23, 1958. A total of eighteen one-week courses will be offered. Fourteen of these will deal with service and four with application of commercial air conditioning equipment.

Instructor for the school will again be Kenneth Russell who has had broad experience in the air conditioning field as a serviceman, trouble shooter, application engineer and teacher. Each course includes classroom and laboratory sessions. Laboratory service projects cover the full range of commercial air conditioning problems and operations. Application for the course are being made through local American Blower branch offices or distributors. Registration fee is $15.00. Enrollment in service courses is limited to 10 registrants per week; in application courses, to 20.

First Year Success

First year of operation for the American Blower C.A.C. school was most successful, according to Mr. Hosler. Certificates of achievement were awarded to 86 men who completed the service course and to 60 who completed the application course. Widespread interest created by the school is indicated by the number of different states and countries from which came the 1956-57 registrants. Students attended from 18 different states and three foreign countries. At press time, Cecil P. Shaw, American's public relations manager, announced that the October classes were already filled.

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Armstrong Cork Personnel Changes

A REALIGNMENT of responsibilities for Industrial Insulation Sales and Contract Operations of the Armstrong Cork Company effective September 1 has been announced by A. E. Pearce, general sales manager of the Insulation Division. The changes are being made as a result of the scheduled retirement on that date of Sloane C. Martin, manager of Low Temperature Insulation Sales and assistant manager of Contract Operations. Mr. Martin is a veteran of 37 years service with the company, having joined Armstrong in 1920 following his graduation from Geneva College and military service during World War I.

Sloane C. Martin

J. W. Liddell

J. P. Sawyer

F. S. Donnelley

J. W. Liddell will continue as manager of Contract Operations, being responsible for sales efforts and execution of all Industrial Insulation contracts. Under the realignment, he has been assigned the additional responsibility for outright sales of jobbed and private label brand products, including sundries. The position of Assistant Manager of Contract Operations is discontinued.

J. P. Sawyer has been appointed manager of Low Temperature Insulation and Insulating Refractories Sales. Sawyer previously served as Assistant Manager of Industrial Insulation Sales and Manager of Insulating Refractories.

F. S. Donnelly, Jr., who served as manager of Industrial Insulation Sales, will become manager of Armaflex and Sundries Sales and Manager of Market Research and New Product Development. As manager of Market Research and New Product Development, Mr. Donnelly will be responsible for coordination of sales promotion for contract and outright sales, study of broadened market opportunities open to Armstrong in the industrial insulation field as it relates to all present and potential new products, and development of new products in the industrial insulation line.

Sporlan Appoints Boing To Home Office Sales

J. D. Boing

The appointment of J. D. Boing to it's Home Office Sales Department was announced recently by the Sporlan Valve Company. Mr. Boing, formerly with a large manufacturing concern in St. Louis, has wide experience in the control field with emphasis on solenoid valves. In addition to this product, he will assist in the application, promotion and sale of Catch-Alls and strainers. A native of St. Louis, Boing studied mechanical engineering at Washington University in that city.

Vilter Australian Agent

THE Vilter Manufacturing Co. Milwaukee, Wis., has announced a license agreement with an Australian company to produce Vilter's line of high speed compressors for use in commercial and industrial refrigeration and air conditioning installations. The licensee is Gordon Brothers Pty. Ltd., Melbourne manufacturer of heavy machinery, refrigeration and air conditioning machinery. The firm is Vilter's second foreign licensee. The other is in France.

Catalogs and Bulletins

Brochure on York Water Cooling Systems

A NEW 32-page brochure has been prepared by the York Corporation, subsidiary of Borg-Warner, describing the company's single-stage Freon-11 turbo water cooling systems in capacities of 115-350 tons. Profusely illustrated, the three-color brochure contains cutaway diagrams of system components, charts of dimensions and weights of various systems, 12 pages of simplified selection tables giving typical rated capacities, engineering specifications for turbo water cooling systems and other useful data. Available at no cost to architects and consulting engineers, the brochure can be obtained by writing Mr. J. Donald Smith, Advertising Manager, Industrial Division, York Corporation, York, Pa.

Solenoid Valve Catalog

A NEW solenoid valve catalog has been issued by the Sporlan Valve Company St. Louis, Mo. Printed in two colors, the catalog is attractively bound and SAE punched so that it may be used as a separate catalog or filed as a section of Sporlan's general sales manual. The new brochure is divided into six sections dealing with general information, capacities, specifications, installation and service, special applications, and the solenoid pilot control.

Classified Advertising

All classified advertisements are payable in advance. Except for Positions and Help Wanted classifications, this section is reserved exclusively for USED equipment.

RATES: 20c per word; minimum 25 words. $2.00 per line for bold face headings: $15.00 per inch for line listings.

Ice Plants For Sale

FOR SALE — Modern 99 ton ice plant complete with masonry building, or separately. Bargain. 51 N. 2nd St., Stroudsburg, Pa.

FOR SALE—90 ton ice plant and equipment in very good condition; operated thru Aug. 31, 1957; consisting of 1-352, 400# can tank in basket of four, can size 11x22x61. One 576 can (cans submerged) in Arctic Pownall tank 400# cans also 11x22x61; all cans in very good condition, brine treated. One twin Vilter ammonia compressor with Superior gas engine drive, 10x20. One Arctic twin compressor with electric drive. One single Vilter ammonia compressor 10x20 with Superior gas engine drive. Two 9x9 V-belt drive York ammonia compressors with 50 h.p. Fairbanks-Morse motor and starter 440V. One 9½x9¼ Vilter V-belt ammonia compressor, with 100 h.p. G. E. motor 550V with starter. 3 condensers, air blower, many water pumps. Gemco ice scoring machine for 400# blocks, ice crushers; bag weigher, practically new. 10 ton Fairbank springless platform scale in perfect condition. Would like to dispose of this plant immediately. Reasonable prices quoted on request. Kinnett-Odom Company, 6th & Mulberry, Macon, Georgia.

USED EQUIPMENT—wanted & for sale

WANTED — Hydraulic lift truck for bunker icing of railroad cars. 3 to 7 ton capacity. Scottsbluff Ice & Storage Co., P.O. Box 348, Scottsbluff, Nebr.

FOR SALE — Refrigeration equipment; ice equipment; new, used. Advise us your needs. Use "QUICKSEAL" — stops brine tank leaks; easy, efficient, economical. Born Company, 80 East Jackson Boulevard, Chicago 4, Illinois. WAbash 2-2299

FOR SALE—5x5 and 8x8 York compressors. 4x4 self-contained York. 20"x10' receiver. 15 ton shell & tube condenser. 5", 7½" and 9" crank shafts (York). Write E. Niebling, 1546 St. Clair Ave., Mt. Healthy, Cincinnati 31, Ohio.

FOR SALE—cheap. Ammonia compressor and auxiliary equipment. York 4x4 compressor; ammonia receiver 1'x8'; 18"x10'—10-pass shell and tube condenser, magnetic starter, complete with all automatic accessories. W. H. Trego, Box 53, Rossville, Ill.

EASY TO INSTALL—New Ball Valve pictured on page 6 can be easily installed in your compressor. Enjoy better performance from any compressor.

FOR SALE—AMMONIA

4—10"x10" 4-cyl. York duplex D. C. to 225 h.p. motor.
2—10"x10" 2-cyl. York D.C. to 100 h.p. motor.
1—9"x9" 2-cyl. York D. C. to 75 h.p. motor.
4—9"x9" 2 cyl. Frick compressors.
1—7¾"x5" Frick booster.
2—7½"x7½" 2-cyl. York compressors.
1—5¼"x4¼" 4cyl. V/W York booster compressor.
1—6"x5" 2-cyl. York compressor.
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From 20 to 100 ton ice plants, York & Frick.
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1—Jamison overlap walk-in cooler door with flaps.
1—Acme Flow Cold 3 h.p. liquid chiller for water or solution cooling.
1—York stainless steel plate liquid cooler.
1—Leffel 65 h.p. Scotch Marine boiler (125 lbs. pressure) with Auburn stoker.
All above equipment in good condition.
MOUNT VERNON FOODS CO.
1200 West 9th St. Cleveland 13, Ohio
Phone Main 1-2945

FOR SALE—York 9x9 with 50 h.p. motor. Phillips ammonia purger. Vilter 4½ self-contained with 15 h.p. motor. Frick 4x4 self-contained. Shell & tube condensers, receiver. We buy, sell and trade. Write us what you need. Gordon Equipment Co. 6530 W. Jefferson Ave., Detroit 17, Mich.

FOR SALE—One high speed 8x8 York ammonia compressor complete with 60 h.p. D. C. motor and V-belts. One high speed 5x5 York ammonia unit. Several 3x3 high speed York units. 40 square flanged York ammonia return bends on 6" centers. REAL BUYS. The Gus A. Regnier Refrigerating Engineering Co. P. O. Box 1093 New Haven, Conn.

FOR SALE—Three Carrier 30B4 Freon-12 chiller units; approximately 18 months in service. Two units equipped with 100 h.p. 440/3/60 motors, direct connected, nominally rated at 100 ton air conditioning. One unit equipped with 75 h.p., 440/3/60 motor, direct connected, possible capacity of 40 ton refrigeration at 0° F and 9.2# suction. All three units complete with gauge board and controls, including starters. Presently dismantled and ready for loading. Complete lot of equipment f.o.b. storage site at Green Bay, Wisc. $16,-200.00. Write or phone Gartner Refrigeration & Mfg. Inc., 2913 Lyndale Ave., South, Minneapolis 8, Minn. Phone TA 7-3533.

FOR SALE—Canadian Rights to foreign gas responsive control apparatus patent #523124. Device indicates differential pressures and operates contactor, signal lights, etc., for automatic control of foul gas in refrigeration systems. C. C. Fisher, P. O. Box 69, Montebello, Calif.

FOR SALE

8x8 Frick V-belt drive to 60 h.p. motor.
10x10 & 9x9 York ammonia compressors.
10x7¼ & 8x6 York Model D-8 boosters.
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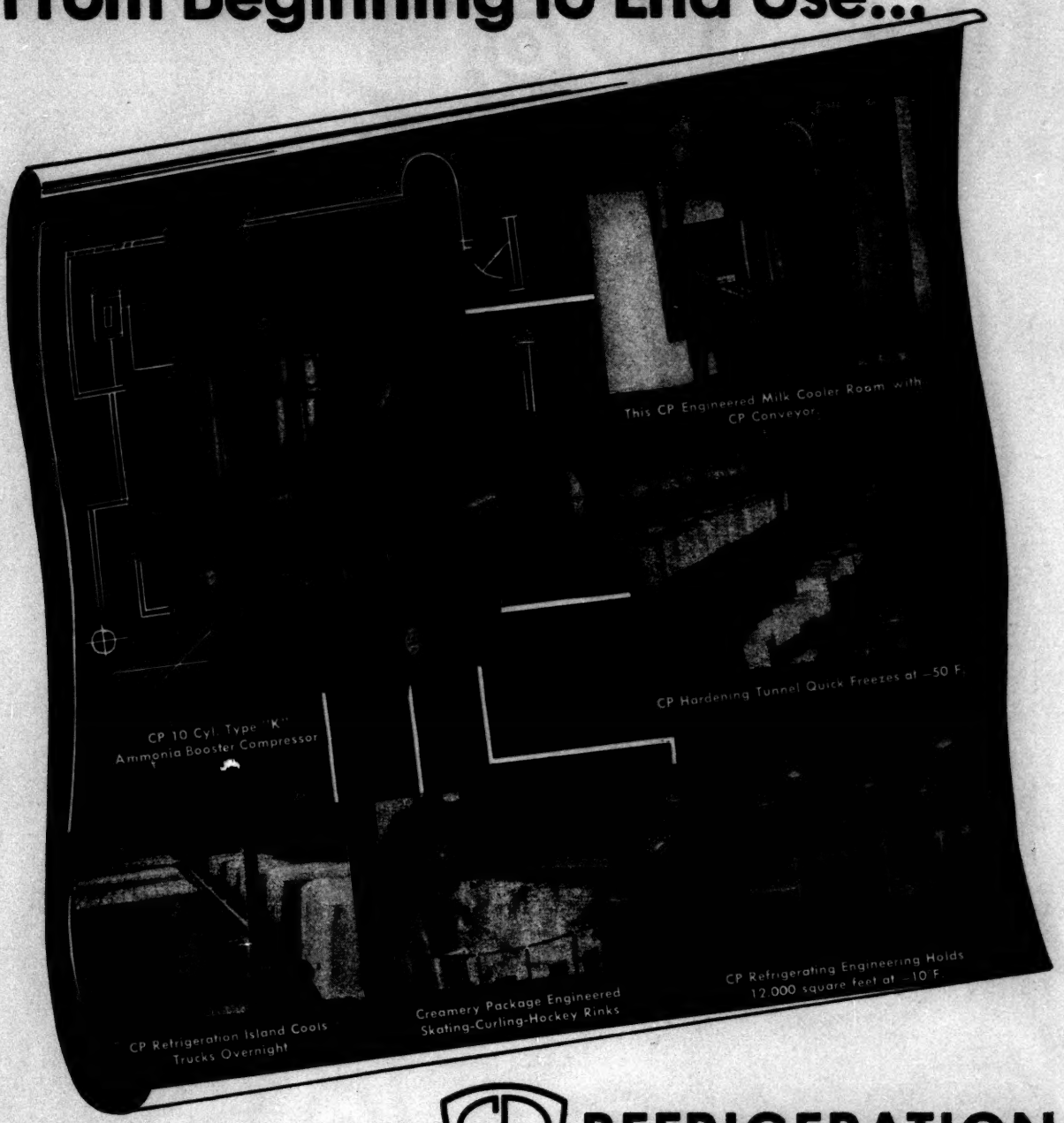
From Beginning to End Use...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...thermoswitch-controlled temperature range eliminates dangers of overheating or condensation of moisture due to unauthorized shut off.

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***60°**—below 60° condensation will form in cable channels on frame and sill areas.*

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With the new Jamison Thermoswitch Control, Frostop *cannot* be turned off at the unit, nor can heat be elevated beyond safe limits. Practical temperature range is from 60°F. to 120°F., which prevents moisture condensation or excessive heat.

Other approved features include Gasketed Control Box—water tight and drip proof; and Silicone-Glass Cable Insulation to give cable moisture and heat resistance and extra long life.

Specify Jamison's new Frostop for completely safe control of icing and freezing of doors. Write for new Frostop Bulletin. Jamison Cold Storage Door Co., Hagerstown, Md., U.S.A.

The new Jamison Frostop with adjustable temperature control is now available on Jamison Cold Storage Doors of many types and practically all sizes.

JAMISON